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THE PERCY SLADEN TRUST EXPEDITION

TO

THE INDIAN OCEAN IN 1905,

UNDER THE LEADERSHIP OF

MR J. STANLEY GARDINER, M.A.

VOL. VI.

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1914—1921.

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No. I.—A REVISION OF THE RECENT COLONIAL ASTRÆIDÆ POSSESSING DISTINCT CORALLITES.

(Based on Material from the Indo-Pacific Ocean and the Collections of Paris, Berlin, Vienna, Copenhagen, London and Glasgow.)

MARINE BIOLOGICAL LABORATORY WOODS HOLE LIBRARY MASS.

By George Matthai, B.A.
(*Research Student of Emmanuel College*), *Zoological Laboratory, Cambridge.*

(Communicated by Prof. J. Stanley Gardiner, M.A., F.R.S., F.L.S.*)

(Plates 1—38 †.)

Read 18th June, 1914.

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* [Mr Matthai wishes me to add in a footnote the part I have played in the preparation of this Report during the three years that he has worked in my Department. We originally intended to examine *Cyphastrea* in collaboration, and indeed we worked together on this genus for over six months, before I retired *solely owing to pressure of other work.* Since then I have constantly seen Mr Matthai and he has demonstrated to me on his sections and specimens most of his facts; we have discussed these facts *but the deductions therefrom are entirely Mr Matthai's*, though with most I concur. The polyp sections were cut by the aid of my laboratory attendants, and will remain with me or be deposited in some place where they will be available for future research by serious students; sections of coral were also cut professionally. Mr Matthai in the course of his research re-examined all my polyp material of *Cœnopsammia, Flabellum, etc.* From time to time I have been in communication with Professor G. C. Bourne, Dr Wayland Vaughan, Professor S. J. Hickson and Mr Cyril Crossland. In particular Professor G. C. Bourne favoured me with a series of most valuable suggestions, as a result of which Mr Matthai spent three months in re-examining his polyp material. A further study of the cytology of the polyps, or some species of coral polyp, is requisite, but it should be undertaken with fresh material.—J. Stanley Gardiner.]

† The Royal Society has generously given a grant of £70 from their Publication Fund towards the cost of the plates which accompany this paper.

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I. INTRODUCTION.

The morphology of the soft parts of fourteen species of *Astræidæ* has hitherto been investigated. Professor Bourne described *Mussa corymbosa* and *Euphyllia glabrescens* in 1888 (**12**), and Dr Fowler *Galaxea esperi* in 1890 (**48**, p. 410). Dr J. E. Duerden in 1902, in a memoir on "West Indian Madreporarian Polyps" (**32**), described some eleven species, viz., *Astrangia solitaria* Lesueur, *Phyllangia americana* Ed. and H., *Cladocora arbuscula* (Lesueur), *Orbicella annularis* (Ell. and Sol.), *Solenastræa hyades* (Dana), *Favia fragum* (Esper.), *Dichocœnia stokesi* Ed. and H., *Isophyllia dipsacea* Dana, *Manicina areolata* (Linn.), *Colpophyllia gyrosa* (Ell. and Sol.), *Meandrina labyrinthica* (Ell. and Sol.). He based a new classification of the *Madreporaria* on a study of altogether sixteen species from which, as far as the *Astræidæ* are concerned, I have entirely to disagree for reasons which will become apparent in the course of this paper.

At the suggestion of Professor Stanley Gardiner, I undertook, in October 1911, a comparative study of the soft parts of Astræid Corals in his collections from the Indo-Pacific Ocean, mainly with a view to determining the natural relationships of the genera and species. In April 1912, Professor Gardiner received further preserved coral polyps from the Red Sea and Ceylon. From these collections I have attempted to study those Astræid genera in which the individual polyps remain separate, the meandering forms being reserved for subsequent examination. Serial sections of about one hundred and fifty polyps from seventy-five colonies were carefully examined, resulting in the determination of seven genera and twenty-seven species. The structure of the soft parts of none of these species had hitherto been described.

A thorough examination of over 700 Astræid specimens (possessing distinct corallites) in Cambridge* left me in considerable doubt regarding the scientific value of the so-called generic and specific characters, on which systematists had based their schemes of classification. The characters usually regarded by them as of value were as follows: (1) the form of growth of the colony (flat or incrusting, massive, branching or irregular with hillocks and valleys); (2) the nature of the inter-calicinal peritheca (broad or narrow, grooved or

* I have had the advantage of discussing these specimens with Prof. Gardiner, who had studied their growth-forms in relation to positions on the reefs.

flat, rough or smooth, vesicular, cellular or dense, the extent to which the spaces between the thecæ were filled with calcareous deposit); (3) the flat or arched character of the dissepiments; (4) the presence or absence of an epitheca; (5) the character of the theca (visible or sunk in the peritheca, its comparative thickness); (6) the number of septal cycles and of the septa constituting each cycle; (7) the nature of the septa (oblique or perpendicular, narrow or broad, exsert or not, presence or absence of teeth on their margins, sides rough or smooth); (8) the presence or absence of paliform lobes* and their shape, size and surface characters; (9) the nature of the costæ (present or absent, visible or sunk in the peritheca, rough or smooth, thick or thin); (10) the nature of the columella†, and the presence or absence of upright rods upon it.

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None of these characters were found to have any constant value, and therefore the distinctions based on them would appear to be arbitrary. Not only were there gradational stages connecting genera like *Orbicella*, *Favia* and *Prionastrea*, and connecting species of the same genus, but in many single large specimens the skeletal characters varied to such an extent that pieces cut off from different parts, if regarded separately, had to be relegated to different species. The descriptions of many coral species have, in this manner, been taken from isolated specimens, hence the enormous multiplication of synonymy in the *Madreporaria*.

Much attention has been paid by various authors to the epitheca. Its origin is still obscure. Von Koch, from his study of the development of *Astroides calycularis* (**78**), regarded it as the continuation of the basal plate, and, as is evident from his figure (fig. 4), a secretion by the ectoderm of the column-wall where it passes into the base or foot. It would therefore be similar in origin to von Heider's eutheca (**64**). Bourne (**12**, pp. 36—39), on the other hand, defined the epitheca as formed "from the free edge of the soft tissues on the exterior of the corallum, as they retreat farther and farther from the original surface of attachment," hence similar in origin to the peritheca‡ deposited between the corallites. Indeed—and in this I am inclined to agree with him—he regards the exotheca, peritheca, cœnenchyme and epitheca as homologous structures, differences, if there be any, depending on quantity and texture. Lacaze Duthiers (**60**, p. 225) also was doubtful about the true nature of the epitheca and how to determine its presence or absence. With reference to

* True pali, arising from the basal plate and situated between the columellæ and septa, have not been seen in any of the Astræids I have examined.

† From the sections of the coralla it is not possible to determine if true columellæ, viz. rods arising from the basal plate and formed in folds of the basal disc of the polyps, are present in Astræids. The so-called "dark centres" are no test as they are seen in all the columellar parts, even in some undoubted septal trabeculæ which have united with and formed part of the columellæ.

‡ I use this term as Professor Gardiner defined it in his paper on *Cœnopsammia*, viz., "That part of the corallum of colonial madreporaria which is deposited outside and subsequently to the theca." Bourne (**13**, p. 217) in a subsequent paper modified the strong views he had at first held on the subject of the epitheca and reverted to von Koch's original contention in these words: "...I may give my adherence to von Koch's definition of epitheca, that it is a more or less conspicuous offset of the basal plate, which lies on the outer side of the body-wall, but no longer forms a part of the surface of attachment, and in the majority of corals has the form of an investment of the column (die Gestalt eines Kegelmantels). As such it is readily recognisable in the anthoblast of *Fungia*, and in some cases I have been able to detect traces of an analogous structure in the anthocyathus (fig. 16, *ep.*)."

Flabellum, characterised by the absence of a "Randplatte" or "edge-zone," Bourne considers the apparent theca as "really a basal structure which has grown upwards to form a calyx" and hence agrees with von Koch's view that it is really the epitheca. As far as the colonial Astræids are concerned the term epitheca may, for the present, be confined to the thin, usually foliated lamina seen at the edges of the corallum.

A study of the arrangement of the mesenteries in the polyps has shown that it is highly misleading to regard the septal cycles, as seen in the dry corallites, as representing the true succession. In genera characterised by the hexameral arrangement of the mesenteries as in my Group I, it often happens that the secondary septa in the entocœles of the secondary mesenteries meet the columella, thus simulating the true primary septa; in other cases the secondaries may be quite as narrow as, or even narrower than, the tertiary septa. The true order of succession of the septa can thus be ascertained only in relation to the mesenterial couples. No such arrangement of the septa into orders can be recognised in the genera belonging to my Group II, which have lost the hexameral disposition of the mesenteries; in these some of the subsidiary septa may meet the columella and some of the principal septa may not; if a cyclical arrangement be recognised in the dry corallites, it is always a later formation, the numbers of the cycles and of the septa composing them being subject to so great variation that they are of little value for purposes of classification.

The above is part of a general indefiniteness in the arrangement of the skeleton. It is not surprising since the corallum lies entirely outside the external ectoderm, the part most open to the free play of the environmental conditions and most liable therefore to be modified by changes in these conditions. This variation is so considerable that a system of classification based on the corallum alone can scarcely be a sure guide to the actual relationships of the animals, for a proper knowledge of which it is essential to make a comparative study of the morphology of the polyps. Bourne, on the other hand, in 1888 regarded any such attempt as futile: "every fresh form that is examined convinces me that the expectations formed of founding a new classification of the *Madreporaria* on the anatomy of the polyp are to meet with disappointment. There is singularly little variation in the forms hitherto examined. Hence I believe that a re-modelled classification must depend on a much more intimate study of the structure of the corallum than has hitherto been attempted." (**12**, pp. 44—45.)

As a result of my study of a limited group of the Astræidæ, it is clear that a thorough re-casting, not only of the species but also of the genera concerned, is necessary. I am further led to suggest that only by a comparative study of both the polyps and their skeletons will a scientific classification be evolved. In the allied group of Actiniæ the importance of the internal characters of the polyps in classification has been fully recognised since R. Hertwig's work on the "Challenger" Actinians.

As an instance of the errors that may be made in basing a classification of corals solely on the hard parts, the case of *Orbicella*, as later extended by Gardiner, may be cited. This genus has to disappear in the light of the new relationships revealed by a study of the polyps of the species included in it. For *O. minikoiensis* Gard.—which has been found to be identical with *Heliastræa heliopora*, Ed. and H.—a new genus has

been created; the species of *Leptastræa* Ed. and H., which Gardiner brought under *Orbicella*, have again been transferred to the former genus, while all the remaining species have been assigned to *Favia*, Oken. In the same manner *Heliastræa forskælana* Ed. and H., and *Orbicella mammillosa* Klunz. have been found to be identical with *Echinopora gemmacea* Lam. *Echinopora hirsutissima* Ed. and H. and *Favia favus* (Forsk.) may be mentioned as examples of species combining a wide range of skeletal variation with identity in polyp-structure.

In order to settle the synonymy of the species it became imperative to examine the type specimens, as it was impossible from descriptions, often without adequate figures, to get any clear idea of their characters. In the summer of 1913 I visited the following museums: Muséum d'histoire naturelle, Paris; Museum für Natürkunde, Berlin; Naturhistorische Hofmuseum, Vienna; Universitets Zoologiske Museum, Copenhagen; British Museum, London, and Hunterian Museum, University of Glasgow. I therein examined the existing types of Lamarck, Milne Edwards and Haime, Ehrenberg, Klunzinger, Forskål, Quelch, and Ellis and Solander; unfortunately many of Forskål's and of Ellis and Solander's types have been lost. In the Berlin Museum I also examined Prof. Studer's "Gazelle" types and some of Dr Ortmann's examples from Ceylon and Dar-es-Salaam. Altogether my work led me to examine 590 specimens in these museums. For great assistance rendered in connection with this part of my work I wish to thank the following gentlemen: Dr Charles Gravier, Dr Lamy, Profs. Dr Brauer and Dr Weltner, Hofrat Dr Steindachner, Prof. Dr Jungerson, Dr Harmer, Prof. Graham Kerr and Dr Agar. Particularly I desire to thank Dr Gravier, Dr Weltner and Dr Mortensen for sending me photographs of some of the type specimens in their museums to be reproduced in this paper. I am indebted to the managers of the F. M. Balfour Fund, Cambridge, for financial aid in connection with these visits.

I also had the great pleasure and advantage of discussing species in *Madreporaria* with Dr Emil v. Marenzeller, whose beautiful work on corals is so well known. It would be an impertinence were I to speak of his great power of discrimination, particularly in his study of *Favia savignyi* Ed. and H. and *F. okeni* Ed. and H., species with which I have had to deal. The collections he studied were extensive and he visited practically all the European museums which possess types. I differ from him in considering that the *Madreporaria* must be studied in their entirety, not on the skeleton alone.

In settling the nomenclature of a known species, either the earliest recorded name may be taken, as was Milne Edwards and Haime's aim in their great work on corals, or, as Dr Marenzeller held, selection may be made of the particular name which is accompanied by the best description and figures. In the latter case due credit would be paid to the author who had undertaken the most complete study of the species, but in a group like the *Madreporaria*, in which the synonymy has been so enormously complicated with specific descriptions of varying merit, opinions would of course differ as to which was the best account; hence a determination of this kind would be largely left to the fancy of the particular worker. I have adopted the method of employing the earliest names wherever possible, even though the descriptions be of the scantiest nature. This in Madreporarian corals can, in my opinion, be done in the case of a species only if its first recorded type

specimen is available. Fortunately most of the earliest types of the species discussed in this paper are still existent in the various museums visited. Regarding the species of the American authors I have referred only to those whose characters could be made out either from descriptions or from figures.

In the systematic part of this work the plan followed has been to base species and genera on the characters of the soft as well as of the hard parts by a comparative examination in every possible case of polyps from different colonies and of as many hard specimens as were available. Thus it has been possible in many cases to study the variation that the corallum undergoes, the principal forms being shown in the photo-plates. Owing to lack of polyp-material, only the probable specific rank of some species can be indicated by recording their skeletal characters. Notes on the specimens examined in the various museums are also given under each species.

Finally I would remark that there should be little cause for complaint in the task of cataloguing examples of known species in a museum. In my visits to museums I found that any species whose limits had once been settled by the study of both polyps and hard parts could be recognised later from the hard parts alone. Only in the case of undetermined species should it be necessary to examine the polyps.

II. ANATOMY OF THE POLYPS (Plates **1—10**).

Method. The material had been in the first place fixed in a saturated solution of corrosive sublimate and preserved in 90 °/₀ pure alcohol; some were killed first in formic aldehyde poured into seawater. From each specimen two pieces were chipped off, one to be decalcified for the soft parts and the other to be macerated for the hard parts; the decalcification was done in weak solutions of nitric acid. Polyps to be sectioned were then embedded in the usual way*, and sections cut to thicknesses of 12 μ, 10 μ, 8 μ, 6 μ, 4 μ. After repeated experiments with various stains, I found that Haidenhain's iron hæmatoxylin followed by eosin gave the best results; the former stains the nuclei, muscle-fibres and nematocyst threads dark, and the latter colours the cytoplasm light pink and the mesoglæa deeper pink. All the polyps whose histology I have studied were treated by this method.

Body-layers. From an examination of sections of coral polyps I am led to think that the ectoderm and endoderm are not composed of definite units known as cells. The usual appearance presented by each layer is that of a sheet of protoplasm with nuclei either closely aggregated as in the ectoderm or somewhat scattered as in the endoderm; an extreme case is that of the stomodæal ectoderm, in which the nuclei are so numerous and so closely packed together that it is difficult to see how there could be cell-limits.

* In connection with the Meandroid Astræids, I cut some sections in gelatin with Aschoff's CO_2 freezing microtome, a method recently employed by Mr J. F. Gaskell ("A Method of cutting frozen Sections by embedding in Gelatin," *Journ. of Pathology and Bacteriology*, vol. XVII, No 1, p. 58, 1912). The advantages of this method consist in the avoidance of absolute alcohol, xylol or paraffin, which usually shrink and distort the internal organs of the polyps, and in the better chance of preserving the histological condition of the tissues as the object has not to be subjected to a temperature above that of the room, but there is great difficulty in making serial sections and no method has yet been devised of dissolving out the gelatin from the sections. These sections in general confirm the account of polyp cytology given subsequently.

Gardiner too could hardly distinguish cell outlines in the ectoderm and endoderm in his sections of *Cœnopsammia* and *Flabellum*; with regard to the calicoblastic layer of the latter genus he says (**50**, p. 139), "I can only regard the layer as an enormous syncytium, and for the growth of a septum there would seem to be a flowing up of the protoplasm on either side." The only structures with definite boundaries which may be regarded as cells are, as suggested below, the nematocysts and reproductive elements. Whether the syncytial appearance of the body-layers is a secondary feature due to the fusion of cells or is the original condition persisting in the adult cannot at present be decided. It is possible that the two layers may arise and continue as sheets of protoplasm with the nuclei multiplying by division without corresponding fission of the protoplasm. But of course no definite view as to the real nature of these layers can be formed without studying their development and without fresh polyp-tissue.

Structures similar to the gland cells (both mucous and granular) of Actinians as described by various authors are present in the ectoderm. In my sections they look like vacuoles, their cellular nature being doubtful. They often appear non-nucleated or with more than one nucleus in their walls. The mucous type (figs. 2 and 3) is oval or flask-shaped, usually with the broader end turned towards the free surface; it occurs in varying numbers in all the species, in the oral-disc, edge-zone, tentacles and the convolutions of the mesenterial filaments, and contains some kind of mucous material which stains brown. The granular type (figs. 11 and 66) is either flask-shaped or elongated, the granular contents, whose nature and function are uncertain, staining dark; it is usually present in the mesenterial filaments, less frequently elsewhere in the ectoderm.

The Hertwigs (**66**) supposed the granular cells to be stages in the development of the mucous ones, whereas H. V. Wilson (**122**) regarded the two types as distinct, since they are distinguishable from the start and have a different distribution in the early developmental stages of *Manicina areolata*.

Small oval sacs, showing finely granular contents stained light pink, are usually present in the ectodermal ridges of the stomodæum as well as in the mesenterial filaments (figs. 23 and 45). These perhaps belong to the granular type and their contents may be digestive in function.

The endoderm is often vacuolated, the vacuoles being oval or goblet-shaped; nuclei are less numerous than in the ectoderm and occur between the vacuoles, or the latter may appear multi-nucleated. The vacuoles are usually more or less transparent, except in the mesenteries, where in some species, *e.g. Cyphastrea serailia* (Forsk.), they stain reddish-brown (fig. 4). The exact nature of these vacuoles is unknown.

Willem (**120**) regarded the endoderm as mainly absorptive and excretory and the mesenterial filaments as capable of secreting a digestive fluid. In addition to extra-cellular digestion Willem also refers to intra-cellular digestion in the endoderm, whereas Gardiner (**49**, p. 375) rejected the possibility of the endoderm having any digestive function, regarding the layer as being homologous with the mesoderm of Triploblastica. Bourne (**17**, p. 225), however, later suggested that in *Heterocyathus æquicostatus* the "glandular-looking cells" may secrete a digestive fluid, and thus disagrees with Gardiner.

Mesoglæa. This name was employed by Bourne (**11**) to replace the term "mesoderm" in denoting the supporting lamina of Coelenterates, since by usage "mesoderm" had become identical with the mesoblast of the Triploblastica. The supporting lamina has been described under various names: Milne Edwards and Haime refer to it as the "tunique musculaire," the Hertwigs use the terms "mesoderm," "stützlamelle," "stützsubstanz," while among some English authors names like "supporting lamella" (H. V. Wilson) and "structureless (or basement) membrane" (Gardiner) have been resorted to; McMurrich (**100**, p. 270) compared it with "the limiting membrane which occurs just below the ectoderm" in the higher Metazoa. Bourne's new name was accepted by Haddon (**55**) and van Beneden (**8**), and is now in common use among most English and American authors (Hickson, McMurrich, Duerden, etc.).

Lacaze Duthiers (**92**) and Faurot (**40**) have, however, questioned the necessity for a new name in preference to the older term "mesoderm." The latter author, after careful study, regarded it as composed of lamellæ ("plissements"), which in Actinians are disposed circularly in the body-wall and longitudinally in the mesenteries and are capable of being separated from one another; these lamellæ could be dissociated still further into fibrillæ. The granulations on the mesenterial pleats ("feuillets") seen in transverse sections, which the Hertwigs (and others after them) regarded as the cut ends of the endodermal muscle-fibres, are regarded as sections of "barbelures," which are part of the intermediate substance. In a subsequent work (**42**) Faurot still adhered to the term "mesoderm" for two reasons; "la lame mésodermique, bien que n'étant revêtue qu'en partie par des fibrilles musculaires, est contractile dans toute son étendue. Certaines régions du corps, susceptibles de se contracter très fortement, ne présentent sur les coupes, aucune trace de ces fibrilles. Le disque pédieux notamment, en est complètement dépourvu, et cependant certaines Actinies telles que l'*Actinia mesembryanthemum* peuvent se déplacer sans l'intervention des cloisons, à l'aide de ce disque. Les éléments ectodermiques musculaires dits "immergés" n'existent pas dans le mésoderme de la colonne et cependant cette paroi peut se contracter longitudinalement. Et d'ailleurs, un tissu contractile doit-il nécessairement, soit renfermer des éléments musculaires, soit en être recouvert?" (p. 367); and again, "un autre motif pour ne pas renoncer, jusqu'à présent chez les Actinies, à la désignation de 'mésoderme' c'est qu'il n'a pas encore été formellement démontré que cette couche intermédiaire n'est pas, en réalité, chez ces animaux, le premier rudiment d'un véritable mésoderme. Il me paraît certain d'ailleurs, ainsi qu'on le verra par la suite de ce travail, qu'elle joue un très grand rôle dans la formation du pharynx, des cloisons, et aussi, fait remarquable, de certaines parties (loges) de la cavité du corps" (p. 369). Faurot further suggested from certain observations on the changes in the colour-markings of the tentacles of *Peachia hastata* and on the irregular size of the "plissements" in the column-wall of *Bunodes thallia* that the contractility of the mesoderm is amœboid. In his latest paper (**43**, p. 347) he regards the usual view that the supporting substance is a secretion of the ectoderm or endoderm as vague and not based on accurate observation.

At first the supporting lamella appeared to be a homogeneous substance which uniformly stained in eosin or picro-nigrosin and did not contain any cell inclusions.

Subsequent examination revealed some nuclei and fibrous appearances, whereas Bourne and Duerden did not observe any such structures in the coral-polyps they examined. But owing to the uncertainty that still prevails over the true nature and origin of this intermediate substance the term "mesoglæa" is used in this paper for descriptive purposes without any of the significance that Bourne attached to it.

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Calicoblastic layer of ectoderm (Pl. **1**, fig. 1, Pl. **3**, fig. 25 and Pl. **5**, fig. 53). The calicoblastic layer (von Heider) is discontinuous only where the soft parts are attached to the corallum by means of the wedge-shaped processes described below. Its nuclei are quite characteristic in being large oval sacs arranged in a single layer, in each of which is a central darker spot, possibly the nucleolus. At the skeletal attachments of the mesenteries the calicoblastic layer is considerably thickened and vacuolated in some species (cf. *Galaxea fascicularis*, Linn.), its protoplasm appearing in transverse sections as thin columnar strands. A structureless membrane covering the external surface of the calicoblastic layer and separating it from the corallum, as described by Bourne, could be made out, although torn in places. This membrane is similar in nature and appearance to the structureless mesoglæa of the polyp. The calicoblastic layer is better developed in the edge-zone, cœnosarc and the peristomial region of the body-wall, while towards the base of the polyp it is attenuated.

The soft parts are attached to the corallum by means of wedge-shaped processes, the latter being particularly conspicuous at the skeletal attachments of the mesenteries (fig. 43). Later observations show that these processes are formed not in distinct cells (Bourne's desmocytes) but by modification of the calicoblastic cytoplasm. They may be formed anywhere in the calicoblastic ectoderm. Stages in their development have been noticed, but these require further study. It is unlikely that the striæ in these processes mark the attachments of the muscular fibres of the mesenteries to the corallum as Gardiner suggested for his species of *Cœnopsammia*, since they are found even at the very base of the body-wall and at places other than at the skeletal attachments of the mesenteries, where there are no traces of muscular fibres.

Nematocysts have been sometimes observed in the calicoblastic layer. Duerden (**37**, p. 32) also found "small oval nematocysts with a close spiral thread" scattered throughout the calicoblastic ectoderm of *Siderastrea radians*.

Dissepiments and polypal growth. Bourne, in his account of the anatomy of *Mussa corymbosa* and *Euphyllia glabrescens*, thus described the formation of dissepiments: "There are probably periods of active coral secretion alternating with periods of reproduction in these polyps. During the latter period the thin dissepiments are formed by the basal tissues, whilst in the former period, the septa increase greatly in height, the polyp is, as it were, moved higher up upon the stem, and deserts the old dissepiments upon which it was resting. Then follows a new period of reproduction during which new dissepiments are formed."

It is difficult to see how such a view can be held when we consider that the polyp is firmly attached all along its height to the corallum by means of the wedge-shaped processes which would prevent any periodical moving up of the polyp. My observations show that there is always some tissue in the cavities of the corallites below the base of

the polyp, viz. in the spaces formed by the dissepiments. This could not be the case if the whole of the polyp actually moved up the corallite, and often the dissepiments are not complete partitions stretching right across the calyx. In the face of these facts, it seems to me that the dissepiments are partitions periodically formed across portions of the corallite and of the polyp. When a full series of such horizontal partitions is formed between the septa, etc., the polyp would be divided into two parts, the lower part being cut off from that above; the lower part degenerates while the polyp soon recovers its normal height. Of course where a dissepiment is to be formed the body-wall has to be folded horizontally inwards, and between the two layers of calicoblastic ectoderm thus formed the calcareous material is secreted. By the successive formation of dissepiments in this way the corallites grow in height, with the living polyps occupying only the uppermost chambers. A further reason for holding the view suggested here is the fact that synapticulæ are actually formed as horizontal rods between septa piercing through the intervening mesenteries and a dissepiment is nothing more than a flattened-out synapticulum partitioning off an interseptal space*. Indeed, every stage between a rod-like synapticulum and a complete dissepiment can be seen in the dry specimens.

Ogilvie (**108**, p. 157) referred to a similar origin of the dissepiments in the following words: "The aboral wall draws itself up gradually during the period of active deposit at the septal edge, forming during its updrawal the arched development. Finally the period of 'pause' sets in, and the body-wall between the septa remains supported on its many-arched floor, which is then completed and thickened."

Nematocysts. Boulenger (**10**) used the term nematocyst for "the actual stinging capsule" and nematoblast for "the cell in which the former is embedded, and of which the cnidocil and the stalk are part." In this paper I use the term nematocyst to mean the whole apparatus, viz., the sac, thread and basal filament (if present), the reason for which will become evident from the account of their probable development.

I am inclined to agree with Hadzi and Boulenger that nematocysts are ectodermal structures; their occasional presence in the endoderm of certain polyps may be due either to subsequent displacement or to migration.

Three main types of nematocysts have been met with in the polyps studied, which I refer to as types I, II and III; all of these are liable to variations in the different species. R. Hertwig (**67**) recognised, after a general survey of nematocysts in Actinians, that their form and the nature of their thread was not the same everywhere, and suggested that they might some day become of systematic importance. The subsequent work of van Beneden (**8**) on Cerianthides and of Carlgren (**20** and **21**) on Actinians

* It is doubtful if there is any real difference between true and pseudosynapticula. The former according to Pratz and Ogilvie are said to possess centres of calcification, whereas the latter are described as formed by the union of septal granulations, and hence devoid of any such centres. The Astræidæ are said to have only such pseudosynapticula, but in some of my microscopic sections of their coralla distinct dark centres are visible. Indeed, if the hard parts are formed in the way Bourne has shown, i.e. outside the calicoblastic layer of ectoderm, and not by a calcification of its "cells," the dark centres and lines will have none of the significance that Ogilvie attached to them. Costal synapticula are seen in sections of species of *Favia* and *Goniastrea*.

brought forward further evidence in support of Hertwig's suggestion. My observations on nematocysts in coral polyps lead to the same conclusion.

Type I (Pl. **1**, figs. 2, 3, Pl. **4**, fig. 35, Pl. **6**, figs. 63 and 65). This is the so-called "tentacular type." It occurs not merely in the tentacles but in the edge-zone, oral-disc, ectodermal ridges of the stomodæum and in the straight regions of the mesenterial filaments (rarely in their coiled regions). There is no doubt, as Gardiner has shown, that Bourne mistook nematocysts of this type in *Euphyllia glabrescens* for immature stages of a totally different type, the so-called "mesenterial." A fully developed nematocyst consists of a long narrow sac somewhat trumpet-shaped, widest at its upper end and gradually narrowing towards its base; the wall of the sac appears to be an elastic membrane against whose inner surface lies a slender spirally-coiled filament stained dark, the turns of the spiral being somewhat oblique and its number variable in the different species from fifteen up to fifty. Even under the highest magnification (Zeiss Oc. 12 × ob. homog. immers. 2·5 mm.), I have not been able to detect a spiral round the filament as in type III described below. It merges at the bottom of the sac into a little granular mass. Usually from the base of the sac a slender process passes down which, in the unextruded nematocysts could be traced to the mesoglæa, possibly neuro-muscular, for keeping the nematocyst in position and for the conduction of nervous stimuli. Normally, the nematocysts lie with their upper ends touching the surface of the ectoderm, but, when brought into action, are extruded partly or wholly with the filament ejected but never seen completely uncoiled. The nematocysts attain to their full size only in the tentacular ectoderm, where they are closely arranged to form batteries, elsewhere being shorter with fewer turns of the spiral and never forming batteries.

This type of nematocyst appears to be derived from an ectoderm nucleus. The nuclear membrane grows in size to form the elastic wall of the nematocyst; within it the chromatin-mass breaks up into minute granules (one of the granules in the middle of the sac is conspicuous by its large size), which, by their union, form the coiled filament. As the nematocyst grows in length the turns of the spiral are added to from above downwards. The filament after it has attained its full length terminates in the residue of the chromatin left at the bottom of the sac. The filamentar process passing from the nucleus to the mesoglæa becomes the neuro-muscular process of the nematocyst. In the tentacular ectoderm a nucleus, as it becomes modified, migrates towards the surface of the layer, hence between the row of fully formed nematocysts at the periphery of a battery and the small round nuclei just above the mesoglæa there are various intermediate stages in the development of this type. *According to this interpretation* every ectoderm-nucleus may be regarded as potentially capable of taking part in the formation of a nematocyst.

Gardiner, from his study of *Cœnopsammia*, has given a totally different interpretation of the history of his "tentacular" nematocysts. He regards them as entirely cytoplasmic in origin, the filament being formed by the union of granules in the protoplasm, resembling "both in its development and appearance the elastic fibres in the connective tissue of vertebrates," and states that "no nucleus can in any stage be distinguished within this (nematocyst) membrane," but that "generally the basal end of the nematocyst lies in

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a finely granular mass of protoplasm with a nucleus either oval or rod-shaped." I have carefully examined the serial sections of his polyps of *Cœnopsammia* and have found that the appearances of the tentacular and oral-disc ectoderm in iron-hæmatoxylin are identical with those in my polyps. All the stages in the modification of a round nucleus into a nematocyst can be made out. The nucleus in Gardiner's fig. 7 does not of course belong to the nematocyst, but is simply one of the many nuclei in the ectodermal syncytium.

The Hertwigs (**66**) have given figures of nematocysts from Actinians which resemble type I (Pl. **2**, figs. 12 and 13, Pl. **3**, figs. 5 and 11). In Pl. **4**, figs. 2 and 5, each of these nematocysts is represented as arising in the cytoplasm of an ectodermal cell with the nucleus lying by its side when it is fully developed. Jourdan (**74**) has recorded nematocysts of the same type from the tentacular ectoderm of the Zoantharia he studied (Pl. 3, figs. 10 and 11; Pl. 12, figs. 83—85). In Pl. 5, figs. 32—36 (*Actinia equina*) and in Pl. 15, fig. 108 (*Balanophyllia regia*) he has figured cnidocils which I have not found in my sections. The type of nematocysts which, according to van Pesch (**111**) is so abundant in the tentacular batteries of *Antipathides*, is doubtless the same as type I (Pl. **4**, figs. 5 and 6).*

Type II (Pl. **1**, fig. 8, Pl. **2**, fig. 18, Pl. **3**, figs. 26, 33, 34, Pl. **4**, figs. 37 *a—f*, 38, Pl. **6**, figs. 58 *a* and *b*, 59, and 62). The nematocysts belonging to this type are large oval sacs, broad at one end and bluntly pointed at the other, found everywhere in the ectoderm but principally in the convoluted regions of the mesenterial filaments, where they may be closely arranged to form batteries. Each of these consists of a membranous wall containing somewhat granular contents. A narrow cylindrical structure or axis extends from the upper end of the nematocyst to about two-thirds its length. This consists of a dark-stained axial core, usually straight, sometimes slightly bent, always pointed at its outer extremity, and enclosed in a thin membranous sheath against the inner surface of which lies a fine close spiral, also stained dark; the sheath leaves the pointed extremity of the axial core free. This type resembles in appearance the nematocysts figured by Hadzi (**59**) from certain Hydromedusæ, and by Boulenger (**10**) from certain Craspedote Medusæ. In a few cases I have noticed the pointed tip of the axis projecting beyond the sac, but there is no further evidence of the protrusibility of this nematocyst-organ in any of the polyps I have examined. The nematocyst attains its full size in the convolutions of the mesenterial filaments, being smaller in the ectoderm of the oral-disc and edge-zone. It usually takes up a position at right angles to the surface of the ectoderm, the pointed tip of the axis slightly pushing up the ectodermal surface.

In the tentacle, nematocysts of this type occur in the terminal batteries interspersed among those of type I, but always in a modified form, being much narrower and somewhat longer, and the axis not extending beyond a third of the length of the sac. In some of these there is a faint suggestion of a coiled thread. This variety, owing to its constancy in shape and distribution may be termed type II (Pl. **3**, figs. 26 and 33).

In the genus *Goniastrea* these nematocysts are much narrower and longer and the

* The second type of nematocysts yellow in colour and without any spiral which van Pesch has observed in the tentacular batteries of *Eucirripathes rumphi* may not unlikely be a variety of type II.

axis shorter; this variety may be termed type II *c* (Pl. **6**, figs. 59 and 62); they are usually arranged close together in the coils of the mesenterial filaments. In *G. retiformis* (Lam.) the axis is about three-fifths the length of the sac and somewhat bent, whereas in *G. solida* (Ed. & H.) and *G. pectinata* (Ed. & H.) it is about a quarter of the length of the nematocyst and somewhat swollen in its middle; in the last two species there is also a suggestion of a coiled thread in the sac.

I have met with nematocysts of this type in the calicoblastic layer of certain well-preserved polyps whose corallum resembles that of *Mycedium okeni* Ed. & H.*. Obviously they cannot be of any use in this layer as they are hidden by the corallum, but their presence proves that the power of developing these structures is inherent in the ectoderm everywhere.

In certain species, *e.g. Favia doreyensis*, Ed. & H. (Pl. **5**, fig. 45), I have seen this type of nematocyst in the endoderm, though not in any great abundance as in the ectoderm. Their presence in that layer may be explained in two ways, either that the nematocysts have arisen in the endoderm, or more probably, that nematoblasts have migrated into this layer from the ectoderm and have developed there†.

It is highly probable that the dark-stained axis is a modified nucleus. Certain appearances suggest that a nucleus wanders to the surface of the ectoderm, elongates and becomes modified into the axis, its chromatin forming the axial core and the fine spiral and the nuclear membrane constituting the surrounding sheath. This process is accompanied by the formation of a membranous wall in the surrounding cytoplasm, the latter forming the contents of the sac. A nematocyst of this type would accordingly be a complete cell (Pl. **4**, figs. 37 *a—f*).

In Gardiner's polyps of *Cœnopsammia* nematocysts of this type are present in the convolutions of the mesenterial filaments, but are somewhat narrow, and the dark-stained axis of each extend usually to about a third of the length of the sac, rarely to its middle. Around the axis (Gardiner's "eversible portion") is a continuous spiral as in my polyps, not a "spiral row of short hairs." I have not seen any distinct coiled thread as Gardiner has represented in his diagrammatical fig. 14, nor any definite nucleus in the nematocyst as in his figs. 17 and 18. In a few cases the axis has been forcibly ejected (not everted), as could be seen in Gardiner's section shown in fig. 13, leaving a corresponding space within the sac‡.

Type III (Pl. **2**, figs. 15, 16, 17, Pl. **4**, fig. 40, Pl. **6**, figs. 57, 60, and 61). The largest nematocysts that I have examined belong to this type. Each of them is broader in the middle than at the ends, and consists of a membranous wall, enclosing protoplasmic contents of the same nature as in type II. Running through the middle of the sac, along its whole length, is a somewhat thick protoplasmic core, stained deeper pink than the rest of the contents. In addition to this, there is a long thread spirally coiled along the inner

* The description of this species is reserved for a subsequent paper.

† For migration of nematocysts see Schneider, Hadzi and Boulenger.

‡ The "larger nematocysts resembling those of the body-wall but usually much longer and narrower," which Bourne (17, p. 224) observed in the tentacular batteries of *Heterocyathus æquicostatus* interspersed among the "small nematocysts of the usual form," may, I venture to suggest, be similar to type II *b*, but Bourne has not figured any of them.

surface of the membranous wall, much thicker than in type I, but with far fewer turns of the spiral. In the unextruded condition, it is difficult to make out the exact nature of the thread, but, as in some of my polyps, e.g. *Favia favus* (Forsk.), most of these nematocysts are found with the thread partially ejected, I have been able to study its structure. It consists of an axial strand stained homogeneously dark, enclosed in a thin membranous sheath against the inner surface of which lies a fine closely-wound spiral stained dark. The tip of the axial strand is pointed, and projects in spike-like fashion beyond the sheath. In some of the nematocysts the sheath is partly torn and the spiral broken here and there along the thread. The central protoplasmic core is never everted; indeed it does not appear to have any connection with the thread at all. As in type I, the thread ends at the base of the nematocysts in a small granular mass. This type varies like I and II in the different species, an extreme case being that of *Goniastrea retiformis*, in which the sac is much narrower (Pl. **5**, fig. 49).

There is little doubt that the so-called "ripe nematocysts" of Bourne from *Euphyllia glabrescens*, judging from his figures (Pl. 4, figs. 10 and 12) really belong to this type; its "axial body," which the author believes to be eversible, being probably the central protoplasmic core. I have not met with any peculiar armature at the extremity of the thread, as in Bourne's fig. 11, in any of my nematocysts.

In the three species of *Echinopora* examined, this type has undergone a characteristic modification, in that the sac is not only narrow, as in *Goniastrea retiformis*, but the longitudinal protoplasmic core is absent and the turns of the coiled thread more numerous. This variety may be termed type III *b* (Pl. **2**, figs. 16 and 17).

The large nematocysts with the long coiled thread which Jourdan (**74**) found in the ectoderm of the body-wall of *Corynactis viridis* (Pl. 8, figs. 54 and 55) and in the mesenterial filament of *Balanophyllia regia* (Pl. 15, fig. 113), come under my type. Resembling the latter are also the two nematocysts which Bourne (**17**) has figured from the ectoderm of the body-wall of *Heterocyathus æquicostatus*, but as in Gardiner's representations (*Cœnopsammia*, figs. 15 and 16), the everted thread is covered with long barbs arranged in a spiral. The "medium-sized elongate" nematocysts which Bourne describes in the same paper from the ectoderm of *Dendrophyllia gracilis* (Pl. 4, figs. 25 and 26 *b*), as well as the nematocysts from the mesenterial filaments of an anthocyathus of *Fungia* (**13**, fig. 28), resemble III *b* (Pl. **2**, figs. 16 and 17); I have little doubt that the thread in these cases, if carefully examined, will be found to possess a closely wound spiral. On the other hand, I have not seen the "large elongate oval" nematocysts (Pl. 4, figs. 26 *c*—*e*, which are the same as Pl. 3, fig. 18); they are similar to Gardiner's fig. 14 or 19, but have a longer "eversible portion."

Type III is essentially similar to type II, consisting of a membranous wall, protoplasmic contents and a thread which, like the axis of II, has a dark-stained central core, a thin membranous sheath, and a surrounding fine spiral. The different parts appear also to have the same origin as those of type II, the thread being probably a modified nucleus (the axial strand and the spiral formed perhaps of the chromatin and the sheath of the nuclear membrane) and the membranous wall developed independently in the surrounding cytoplasm. The granular mass at the base of the nematocyst into which the

axial strand merges may be the residue of the chromatin left after the former has grown to its full length. Type III, like II, would then be a complete cell.

If the above study of the nematocysts be confirmed by living material, then the trumpet-shaped body (a modified nucleus) of I would be comparable only with the axis of II and with the thread of III, its wall and filament* being homologous respectively with the sheath and spiral of the last two types, but without a chromatic central core.

Of the four kinds of nematocysts described and figured by Gosse (**53**, Pl. 11), the "spiral cnidæ (cnidæ cochleatæ)," which are confined to the walls of the tentacles and whose thread ("ecthoræum") is without any armature, is in all probability the same as type I, the "chambered cnidæ (cnidæ cameratæ)" and "the tangled cnidæ (cnidæ glomiferæ)" come near type III, the latter having no "barbed bristles" ("pterygia") on the spiral ("strebla") surrounding their thread, while the "globate cnidæ (cnidæ globatæ)" may be glandular structures and not nematocysts.

Previous authors who have made the study of nematocysts agree that they arise in interstitial cells of the epithelium. At first a vacuole is formed in the cytoplasm of such a cell which becomes the capsule of the nematocyst. Opinion is divided as to the nature and mode of development of the filament. Of the many views that have been put forward the two main ones are (*a*) that the filament is formed inside the capsule (Bedot, **4**), (*b*) that it develops outside the capsule, becoming subsequently invaginated into the latter (Jickeli, **73**; Nussbaum, **107**; Murbach, **106**). Iwanzoff (**72**), on the other hand, holds an intermediate position that the filament is at first partially invaginated by its distal end, the invagination becoming complete with the full development of the nematocyst. According to these authors the filament is a cytoplasmic product, the nucleus of the nematocyst persisting outside the capsule.

In the last two types I have not been able to make out a neuro-muscular process as in I, and in none have I observed any process suggestive of a cnidocil.

After completing the above studies of the nematocysts my attention was drawn to a paper by Theodor Moroff ("Entwicklung der Nesselzellen bei *Anemonia*," Archiv Zellforsch. iv. p. 142, 1909), in which the author has traced the origin of the filament to nuclear elements. Moroff has described two kinds of nematocysts from the tentacles of "*Anemonia sulcata*," (*a*) "spirocytes," which are similar in appearance to type I, and (*b*) "nematocytes" which resemble type III. As far as I have been able to understand his description, each of these has a double wall (in transverse sections of my types the walls consist, in every case, of a single membrane), the outer "sklera" being cytoplasmic in origin, while the inner "propria" is chromatic and continuous with the thread which is also formed by the union of chromidia; he regards the axis of the "nematocytes" (fig. M) as continuous with and having the same origin as the thread and capable of being everted. The nuclei as they become modified into the nematocysts wander from the base of the ectoderm to its periphery.

* I have applied the term "filament" to the structure in type I, while the use of the term "thread" is restricted to the complex structure in type III, which consists of an axial strand surrounded by a sheath and by a fine spiral.

Haddon and Shackleton (**57**) observed nematocysts in the endoderm of *Isaurus asymmetricus* and of *Zoanthus coppingeri*; those figured on Pl. 64, fig. 2 bear a certain resemblance to type I. Van Beneden (**8**) also found nematocysts in the endoderm of some larval Cerianthidæ, and gave many figures; he distinguished two main types of nematocysts, the first type closely resembling I, while the second comes near III, but the thread is much shorter in *Ovactis brasiliensis* (Pl. 3, figs. 2, 13, 14, 15). The nematocysts consisting of three sorts from the "botrucnides"* and "cnidorages" of *Hensenanthula* (Pls. 12, 14, 15) bear some resemblance to II, but the pointed extremity of the "fil rectiligne" is directed towards the base of the nematocyst (cp. Pl. 12, figs. 13 and 14, with my Pl. **6**, fig. 58 *a*, *b*), but one of these in the exploded condition shows a long tapering thread. According to van Beneden each of these nematocysts has a semilunar nucleus attached to it, the "fil rectiligne" being presumably protoplasmic, as may be inferred from the developmental stages (Pl. 12, figs. 15—18).

The respective functions of these types of nematocysts and the different ways in which they are used can be ascertained only by means of actual experiments on living polyps. Nos. I and III in all probability have a stinging function, which may account for their mutually exclusive distribution, the latter restricted to the coils of the mesenterial filaments, the former found mainly in the tentacular batteries. On the other hand, type II may not have a stinging function; in this connection it may be pointed out that their sacs sometimes take a brownish tinge in iron hæmatoxylin and eosin like the mucous vacuoles. Could they then have an adhesive function and could that be the reason why they are found interspersed among the nematocysts I in the terminal tentacular batteries as well as among those of type III in the coils of the filaments?

In Gardiner's polyps of *Cœnopsammia* nematocysts III† are present in the convolutions of the mesenterial filaments, but the protoplasmic core has not been met with in any of them. From Gardiner's description and figures it would appear that he regarded these as the final stage in the development of type II. His "mesenterial nematocyst" in fig. 14 is a reconstruction and a combination of types II and III, having both the axis ("eversible portion") and the coiled thread. In a few cases I have seen structures similar to fig. 15 which presumably belong to III, with the greater part of the thread broken off. The appearance of a row of hairs may be due to the breaking of the turns of the spiral surrounding the axial strand; such a condition is presented by some of the nematocysts III of my polyps of *Favia favus* (Forsk.) in which there is no doubt whatever that the spiral round the axial strand has been broken at places. It is also to be noted that while most of the authors cited above place the nucleus in the protoplasm surrounding the nematocyst-capsule, Gardiner in his figs. 17 and 18 has shown it inside the capsule.

* "Botrucnides" is the name given by van Beneden to certain curious endodermal structures having the form of bunches of rounded grains which take the place of acontia in *Cerianthula*, *Hensenanthula* and *Calpanthula*; the individual grains which he has termed "Cnidorages" fall off into the gastro-vascular cavity on attaining their full size.

† Nematocysts II and III in Gardiner's polyps do not appear to have been well fixed.

Gardiner has recorded the general occurrence of nematocysts in the endoderm of the polyps of *Flabellum* on each side of the upper top ends of the septa. These undoubtedly belong to III, which the following considerations render it probable that they may have been at first formed in the calicoblastic layer, their subsequent presence in the endoderm being perhaps due to displacement or migration : (*a*) nematocysts of this type are present in the calicoblastic layer—compare type II in the calicoblast of *Mycedium okeni* Ed. and H.—usually towards the top ends of the septa, some of them being entire with sac, protoplasmic core and coiled thread and lying parallel to the septa with the calicoblastic layer raised over them or in an oblique position partly in the calicoblast and partly in the endoderm; (*b*) in the endoderm no entire nematocysts are present, the wall being, in every case, absent and the coiled thread usually broken; (*c*) they have no definite position, but lie loose in the endoderm; (*d*) the nematocysts in the calicoblastic layer are well stained, whereas in the endoderm they have taken very little stain, probably because of subsequent degeneration.

Gardiner makes no record of such nematocysts in the mesenterial filaments of *Flabellum*, but oval, pink areas with a suggestion of coiled threads can be seen in the convolutions of the filaments*.

Nervous system (Pl. **1**, fig. 3, Pl. **2**, fig. 24, Pl. **5**, figs. 47, 52, Pl. **6**, fig. 66). Nerve cells and fibres† as figured by the Hertwigs for the Actinians have not been met with in my sections. The ectoderm just above the mesoglæa is more granular than usual, being the only indication of a nervous stratum, perhaps representing their "Nervenfaserschicht" and von Heider's "Interbasalsubstanz." This is seen in the edge-zone, oral-disc, tentacles, ectodermal ridges of the stomodæum and the mesenterial filaments, and best of all in the tentacles, perhaps because of their bundles of nematocysts.

Endodermal musculature. This constitutes the main musculature of the polyp; it is present in two regions, viz., oral-disc and mesenteries.

Attached to the lower surface of the mesoglæa of the oral-disc (Pl. **5**, figs. 51, 52) is a thin layer of muscle-fibres disposed circularly, but much less developed than in Actinians and without any mesoglæal pleats which are so prominent in many of the latter (*vide* R. Hertwig, Haddon and van Beneden). Around the outer margin of the bases of the outer cycle of tentacles the muscular layer is somewhat thickened to form a sphincter, the so-called *Rötteken's muscle*; from the appearance of the spirit specimens it may be inferred that its action is to reduce the opening of the peristome by drawing its lateral wall over the oral-disc and hence over the tentacles, which consequently are bent over the mouth. Faurot (**23**) does not regard the sphincter as having any retractile action on the tentacles

* In *Cœnopsammia* Gardiner's figs. 7 and 8 are type I; 9 and 10 are appearances in the protoplasm; 14 is a combination of types II and III; 15 and 16 are probably type III; 17—19 are type II but the nucleus is an optical appearance.

† Havet (**61**) employing better methods has been able to distinguish both sensory and motor nerve cells and fibres in the ectoderm and endoderm of an Actinian *Metridium dianthus*, and has given excellent figures illustrating their arrangement and distribution. Van Beneden could not make out any ganglion cells in his sections of larval Cerianthidæ, although a distinct "assise nerveuse" was present in both the ectoderm and endoderm at the base of the "assise épithélioïde" and just above the "assise musculaire." Faurot could not find such a nervous layer in the endoderm of the Actinians he studied.

of Actinians. The oral-disc muscle is continued as a much weaker layer into the outer wall of the edge-zone. R. Hertwig (**42**) laid great stress on the systematic value of the circular muscle for both the genera and species of Actinians.

The mesenterial musculature consists of a longitudinal layer of muscle-fibres on either side of every mesentery attached to its mesoglæa (Pl. **1**, fig. 4, Pl. **2**, fig. 13, Pl. **3**, fig. 27). As a rule, on all the mesenteries except the directives, the entocœlic layer is much better developed than the exocœlic, the mesenteries bearing entocœlic mesoglæal pleats or muscle-banners (Faurot's "feuillets") for the insertion of the fibres. These, usually known as the "retractors" (Fowler, Bourne, etc.), are attached from the oral-disc to a varying distance below the enterostome, and usually extend from the stomodæum to the column-wall; they are best developed in the stomodæal region of the mesenteries. No specialised parietal muscles are present as in Actinians; the entocœlic muscular layer may, however, be regarded as representing on that side both the parietal and the "faisceau unilateral" of Faurot. By the contraction of this entocœlic layer, a downward pull is exerted on the whole oral-disc, thus bringing about the shortening of the whole polyp. In the non-pleatal region of the primary mesentery, a varying distance from the stomodæal attachment of the latter, the entocœlic muscle-fibres are obliquely directed inwards and lie within the mesoglæa. They are obviously attached to the stomodæum, and by their contraction bring about the widening of the stomodæum which is a characteristic condition of the retracted polyps. The exocœlic layer has about the same vertical extent, but the fibres are quite perpendicular, fewer and thinner; by their contraction they can only aid the entocœlic fibres in shortening the polyp, and hence the term "protractors" as applied to them by Fowler (**26**, p. 252) and others is a misnomer*. The exocœlic fibres are more distinct on the inner half of the primary mesentery in the stomodæal region, presumably because the entocœlic fibres in the inner half function for widening the stomodæum rather than for shortening the polyp.

Fowler (**44**) believed that the exocœlic muscle-fibres of the mesenteries could be continued into the tentacles to form their external longitudinal coat, but to this view there are two obvious objections: (*a*) the fibres have, on such a view, to pierce their way through the mesoglæa of the oral-disc in their upward course to the tentacles; (*b*) the external tentacular muscle-fibres are said to be ectodermal, whereas the exocœlic fibres are endodermal; moreover Fowler's fig. 5 is only a diagram. Exocœlic pleats are present only in a few species.

The condition of musculature is reversed on the directive mesenteries.

Hollard (**71**) and the Hertwigs described the muscular fibres on the faces of the mesenteries of Actinians opposite the longitudinal retractor muscles as running transversely, while Faurot could find neither fibres nor pleats on that side and suggested that those authors might have mistaken the simple folds formed by the contraction of the mesoglæa for permanent pleats. The parietal muscle of Actinians is unrepresented on the exocœlic side of the mesenteries of coral polyps.

* Gardiner observed a more or less similar condition in *Cœnopsammia*. On p. 366 he says "On the faces of the mesenteries, opposite to the great retractor muscles, there are a few isolated longitudinal muscles with a similar course....There do not appear to be any definite protractor or transverse muscles."

Ectodermal Musculature. This is extremely weak in all the polyps and consists of (*a*) the filamentar processes occurring in the ectoderm of the oral-disc, edge-zone and tentacles whose course may be traced from the nuclei to the mesoglæa, perhaps being neuro-muscular offsets, and (*b*) a thin layer of fibres with a longitudinal or oblique disposition, which has been recognised in the larger tentacles of some of the polyps. The latter layer begins at the oral-disc and extends up along the entire height of the tentacles, but does not appear to have any connection with the mesenterial musculature. It perhaps assists in shortening the tentacles.

In my polyps I have not found a circular endodermal or a longitudinal ectodermal muscular layer in the column-wall nor are there ectodermal muscular fibres arranged radially in the oral-disc as described by van Beneden for certain Cerianthidæ (**8,** Pl. 5, fig. 7).

Oral-disc (Pl. **5**, figs. 51, 52). The terms "oral-disc" ("disque buccal," van Beneden) and "peristome"* have been loosely applied to the upper surface of the Anthozoon polyp. In this paper the former name, which is synonymous with the "mouth-disc" ("Mundscheibe" of German authors) of Fowler and Gardiner, is used for the circum-oral area delimited by the outermost cycle of tentacles, this being conterminous with Rötteken's muscle, while "peristome" is employed to denote the circum-oral space. The mouth is situated in the centre of the oral-disc.

The ectoderm of the oral-disc has a columnar facies, with oval nuclei of varying size arranged along its middle. In these nuclei chromatin granules are visible, usually round a somewhat larger darker spot, apparently the nucleolus. Above this layer of nuclei the protoplasm is, as a rule, opaque, containing vacuoles usually of the mucous type, rarely of the granular, while below the protoplasm is somewhat transparent and finely granular. In many of the species deeper-stained protoplasmic areas are visible, each containing a nucleus; these diverging from the nuclei towards the free surface of the ectoderm. Round nuclei are much fewer, more or less homogeneously stained, and occur in the lower half of the ectoderm. Type I nematocysts (see p. 11) are present in varying numbers in the upper half of the ectoderm, occasionally type II also.

The endoderm varies in its thickness and in the extent of its vacuolization, the nuclei being smaller than in the ectoderm and more or less homogeneously stained. Algæ are usually abundant, sometimes massed so that the endoderm is hardly distinguishable.

When it is considered that the convolutions of the mesenterial filaments containing nematocysts are frequently protruded through the oral-disc, that the peristomial ectoderm is provided with nematocysts and mucous vacuoles, the latter secreting an adhesive fluid, and that the tentacles which arise from the oral-disc are charged with batteries of nematocysts and also with mucous vacuoles, it is evident what an effective apparatus the peristome is for capturing prey.

* Faurot (42) takes objection to both these terms and introduces a new name "oro-tentacular disc" (disque oro-tentaculaire), which according to him makes its appearance, in Hexactinians, at the same time as the first eight tentacles. This name has no advantage over the older "oral-disc." Indeed, the latter is capable of wider application, since in the coral genus *Hydnophora*—which I have recently begun to study—the tentacles are arranged in circles round the conical eminences or monticules, without any reference to the mouth openings which lie in the depressions between the monticules.

Column Wall (Pl. **3**, fig. 25 and Pl. **5**, fig. 53). This term denotes the vertical portion of body wall* outside the oral-disc. The greater part of its ectoderm (*i.e.* the part lying against the corallum in the fully expanded condition) is the calicoblastic layer already described. The mesoglæa between the calicoblastic layer and the inner endoderm is much attenuated except at the attachments of the mesenteries to the corallite-walls (Pl. **2**, fig. 22). The inner endodermal layer is usually thin in the region above the enterostome and contains a single layer of small more or less homogeneously stained nuclei. Towards the base of the polyp the endoderm becomes, as a rule, highly vacuolated and consequently appears much swollen, reticulated and transparent; nuclei are either absent, as in my polyps of *Galaxea*, or, when present, arranged along its free margin. Algæ here are rare or quite absent. The mesoglæa is always extremely thin over the calicoblastic layer (Pl. **2**, fig. 22).

The column then bears a strong contrast to that of Actinians, in the presence of the calicoblastic layer of ectoderm, the thinness of the mesoglæa and the absence of an external or internal muscular layer.

Edge-zone and Cœnosarc (Pl. **1**, figs. 1, 2, and Pl. **2**, fig. 24). I use these terms in the sense in which Professor Gardiner has defined them, viz., "The cœnosarc is that part of the polyps in a colony which lies outside but not above (*i.e.* in expanded state) the thecæ of the several corallites. The 'Rand-platte' of Heider and von Koch, and 'edge-zone' of Ogilvie, is then that part of the cœnosarc which lies over the free portions of the corallites" (**49**, p. 361). It is to be noted that the distinction between the two structures is a physiological not a morphological one.

The edge-zone has an outer and an inner wall, the former being an extension of the oral-disc, and the latter of the body-wall, and enclosed between those is an extension of the gastro-vascular cavity of the polyp. All the mesenteries are extended into the edge-zone. The structure of the outer wall of the edge-zone is more or less similar to that of the oral-disc, and of the inner wall to that of the column-wall. The extent of the edge-zone depends upon the degree of exsertness of the corallite ; in the case of *Galaxea fascicularis* (Linn.), in which the corallites project conspicuously above the peritheca, the edge-zone is very extensive as it covers the entire free surface of the corallite, whereas in *Goniastrea retiformis* (Lam.), in which the corallites do not project above the general surface of the colony, the edge-zone is absent.

The cœnosarc covers the free surface of the peritheca, being only a continuation of the edge-zone with which it is similar in structure. The extent of the cœnosarc between neighbouring edge-zones depends upon the perithecal distance between the corallites. In species like *Goniastrea retiformis* (Lam.), in which the corallites are so closely aggregated that there is no peritheca between them, the cœnosarc is also absent.

Tentacles (Pl. **1**, figs. 3, 11, 12, Pl. **2**, fig. 19, Pl. **3**, figs. 26, 28 and Pl. **5**, fig. 44). The tentacles arise from the oral-disc as hollow vertical outpushings of the inter-mesenteric

* Body-wall comprises the entire wall of the polyp surrounding the gastro-vascular cavity, viz. the oral-disc with the tentacles above, the basal-disc below, and laterally between these the column-wall. The basal-disc is pushed up by the columella and paliform lobes, its ectoderm being the continuation of the calicoblastic layer of the column-wall and its endoderm usually vacuolated as in the lower part of the column-wall.

chambers; following Fowler's terminology those from the entocœles are known as "entocœlic tentacles" ("tentacules loculaires" of Faurot) and those from the exocœles as "exocœlic tentacles" ("tentacules interloculaires" of Faurot). They do not always agree in numbers with those of the entocœles and of the exocœles. In the retracted condition of the polyps, I have not been able to make out more than two cycles—an inner and an outer—the former being composed of the entocœlic tentacles, and the latter of the exocœlic tentacles. The term "cycle"* refers to those tentacles which form a circle, *i.e.* which arise from about the same radial distance from the mouth. In some species one of the two cycles is absent. When the polyps are retracted, the tentacles are usually bent over the oral-disc, so that, in transverse section, they are cut longitudinally; they are also capable of complete introversion, *i.e.* of being turned outside in. A tentacle can be distinguished, from any mere fold of the peristomial wall, by the swellings caused by the presence in its ectoderm of batteries of nematocysts.

A large terminal battery is always present which makes the tentacular tip knobbed or bluntly pointed; such a battery consists of a peripheral row of closely arranged type I nematocysts with II *b* ones interspersed among them. Much smaller subterminal batteries are present in most of the polyps; the number constituting a longitudinal row is of specific value. In these batteries only type I nematocysts are present; they spread outwards towards the periphery, hence their arrangement in each battery appears fan-shaped in transverse section. Nuclei are numerous below the peripheral row of nematocysts; those towards the mesoglæa are round and homogeneously stained, while those towards the nematocysts are elongated, saccular and granular. There are no diverging tracts of protoplasm as in the oral-disc and edge-zone, but like the latter filamentar processes (neuro-muscular) pass from the nuclei towards the mesoglæa. As described on p. 17, a longitudinal muscular layer and a granular nervous layer are present.

The endoderm varies considerably in thickness from being extremely thin to being so thick as almost to occlude the lumina of the tentacles.

Stomodæum (Plates **7—10**). Van Beneden in 1898 questioned the use of terms like stomach, pharynx, œsophagus to denote the tubular structure of the Anthozoa. He objected also to the use of "stomodæum" on the ground that the organ in question is not homologous with the stomodæum of the higher Metazoa. In like manner, he held that any general use of the word "mouth" would lead to confusion. Both terms are here retained without having recourse to new names like "Actinopharynx" and "Actinostome." On the other hand, van Beneden's "enterostome" is a much needed name to denote the lower opening of the stomodæum into the gastro-vascular cavity or cœlenteron.

The stomodæum ("stomatodæum" of Fowler and McMurrich) in coral polyps is usually flattened from side to side in common with most of the Anthozoa, rarely being circular in transverse section. The mouth in many polyps forms a more or less

* Faurot (40, p. 58), uses "cycle" in practically the same sense, *i.e.* to denote the rings of tentacles, and "order" when referring to the sequence of the circles of mesenteries. According to him, in Actinians, the exocœlic tentacles, which are smaller than the entocœlic ones, constitute the last cycle but are formed at successive periods in the exocœles, following the appearance of the orders of mesenteries.

conspicuous rim. Over the attachments of the mesenteries the ectoderm is raised up into ridges which differ in width, thickness and shape in the different species, these characters being of specific importance. By the presence of these ridges, longitudinal furrows ("sillons actinopharyngiens" of van Beneden) are formed. In the genera of Group I below, characterised by the presence of two couples of directive mesenteries and both bilateral and radial symmetry*, two longitudinal grooves are present facing the directive couples of mesenteries, being usually deepened by the folding of the stomodæal wall into the directive entocœles. The stomodæal ectoderm is ciliated, but the cilia do not appear to be longer in either of the grooves, nor is the ectoderm lining them specially thickened. Although these grooves are not so pronounced in my sections as the so-called sulcus of *Peachia* or the sulcus and sulculus of *Bunodes*, they are not less evident in transverse sections than the same grooves in some examples of *Edwardsia* and *Zoanthus* that I have examined (they are well seen in my sections of *Echinopora lamellosa*, *Leptastrea roissyana* and *Galaxea fascicularis*). On the other hand, Duerden denies the existence of any such groove ("siphonoglyph") in the *Madreporaria* (**21**, p. 23); Bourne also is inclined to take the same view. Duerden further says "a siphonoglyph is generally wanting only in the lowest actinians and in alcyonarians, and its absence in coral polyps would suggest their more primitive nature." These two grooves are here termed directive grooves†, as they lie in the directive entocœles; none of the other names hitherto employed to denote them in the Anthozoa are suitable for coral polyps.

Great confusion prevails over the orientation of Actinian polyps and in particular over the terminology employed to denote these two grooves. Hollard in 1851 (p. 274) referred to them as "deux demi-canaux"; Gosse in 1860 (p. 4) termed them "gonidial grooves (canales gonidiales)"; the Hertwigs in 1879 distinguished them as "ventral" and "dorsal," following upon Kölliker's (1872) use of "ventral" for the side of a Pennatulid polyp turned towards the stem and "dorsal" for the opposite side. Following Haddon objection may well be raised against the extension of these terms to the Actiniæ. In 1884 Andres (p. 73) substituted "gonidium" and "gonidulum" for Gosse's gonidial grooves. Hickson in 1883 (p. 693) invented "siphonoglyphe" for the ciliated groove of Alcyonarians which is said to be homologous with the single groove of *Peachia* and the ventral grooves of other Actinians; Parker (**110**) in a foot-note on p. 260 drops the final *e* with Hickson's assent, as etymologically unnecessary; both he and McMurrich apply "siphonoglyphs" to the two grooves in Actinians.

Haddon in 1889 (p. 300) introduced "sulcus" for the more important groove of Actinians (viz. ventral groove of the Hertwigs) and "sulculus" for the opposite (dorsal) one. Haddon's nomenclature, which has been accepted by Bourne, van Beneden and others, is as objectionable as the Hertwigs' "ventral" and "dorsal" when applied to adult Actinians in which there is no recognisable difference in the size of the two grooves. The distinction between ventral and dorsal, sulcar and sulcular, may be

* Boveri (**18**) uses biradial symmetry to denote the combination of both the bilateral and radial symmetry in Actinians.

† Perhaps Faurot's commissural grooves ("sillons commissuraux") and commissural mesenteries may be preferable to "directive grooves" and "directive mesenteries."

appreciated in the case of forms like *Edwardsia*, where the longitudinal muscles of all the non-directive mesenteries are turned to one pole, but in adult coral polyps, with the hexameral arrangement of the mesenterial couples and with no appreciable difference in the relative size of the two grooves, it is impossible to distinguish one pole from the other. Parker (**110**, p. 268) pointed out the same difficulty in the "diglyphic" forms of *Metridium*. In my Group II, in which neither directive mesenteries nor directive grooves are present in the adult condition, the distinction breaks down. Reliable criteria, if there be any for determining one pole from the other, can be expected only from a comparative study of the developmental sequence of the mesenteries. Van Beneden, homologising a cerianthid larva with the segmented larva of *Amphioxus* or the embryo of *Peripatus*, substituted anterior for ventral, posterior for dorsal, the oral-disc being regarded as dorsal or "face neurale." Faurot, after his exhaustive embryological studies of Hexactinians, prefers to use ventral and dorsal instead of sulcus and sulculus.

In my Group II, in which directive mesenteries and bilateral symmetry are wanting*, no two grooves are distinguishable from the others, but in many polyps the grooves appear (in transverse section) on the whole deeper than in Group I, owing to the folding of the stomodæal wall into the inter-mesenteric chambers. G. Y. and A. F. Dixon (**27—30**), Carlgren (**20**), McMurrich (**98**, **99**) and Parker (**110**) have observed variations in the number of directive grooves above and below their normal number (also total absence) within the same species of certain genera, viz. *Sagartia*, *Bunodes*, *Metridium*, and have correlated it with a corresponding variation in the number of directive couples of mesenteries. Parker and McMurrich studied this variation more thoroughly in the case of *Metridium marginatum* and *Sagartia spongicola*, emphasising the numerical correspondence between directive couples and grooves. Perhaps a similar relation subsists in coral polyps also, as will be seen by a comparison of Group I with Group II.

The stomodæal ectoderm has a faintly striated border below the row of cilia. Its nuclei are round, rod and spindle-shaped, and more or less homogeneously stained dark; they are massed together in each ridge below the striated border, around a deeper, somewhat granular region, which is almost devoid of nuclei. The nature and arrangement of the nuclei give this ectoderm a characteristic appearance. Through the central protoplasmic region, slender filaments generally pass backwards into the mesoglæa. Nematocysts are never numerous; when present, they may belong to any of the three types. Small vacuoles, as described on p. 7, are usually present in the peripheral protoplasm above the layer of nuclei.

The endoderm is, as a rule, extremely thin, and algæ are comparatively rare. The mesoglæa may or may not be thickened at the attachments of the mesenteries; when thickened, it projects into the ridges.

Mesenteries. In coral literature there has been a great confusion in the terminology employed to denote the soft radial partitions of the polyps and the calcareous partitions of the corallites, "septa" having been used for both the structures by some English and German authors and "cloisons" by French authors. The name "mesenteries" ("les mésèntéroïdes" of Lacaze Duthiers) is now well established for the radial partitions of the

* A trace of bilateral symmetry is however left in Group II in the lateral compression of the stomodæum.

polyp, and "septa" ("cloisons") is restricted to the calcareous radial partitions of the corallites.

Hollard in 1851 described at length the arrangement of the mesenteries of Actinians in two's, with their respective longitudinal muscles facing each other; this arrangement has since been recognised in all Hexactinians.

In polyps of Group I the couples of mesenteries are arranged in alternating cycles, each cycle consisting of six couples of almost uniform width or of a multiple of six, the mesenteries of every succeeding cycle being narrower than those of the preceding one. In the polyps examined thus far, up to four cycles of mesenteries are present, termed respectively primary, secondary, tertiary and quaternary. The so-called "directive" couples* of mesenteries belong to the primary cycle, and are situated at the ends of the longer diameter of the stomodæum, each enclosing a directive groove; their arrangement of the mesoglæal pleats with muscular layers is reversed†.

For such a disposition of the mesenteries in the adult polyps I prefer to use the term "couples," and "pairs" when referring to their developmental sequence. The word "cycle" is used to include all the couples of mesenteries having more or less the same radial extent, irrespective of their time of development, while "order" has been employed by some authors (Faurot) to denote the mesenteries which have appeared at about the same time to form a circle, *e.g.* primary order, secondary order, etc. The couples of mesenteries composing the first cycle are usually "complete," *i.e.* they extend from the column-wall to the stomodæum; when one of the mesenteries of a couple does not reach the stomodæum, the couple is spoken of as "incomplete‡."

In *Diploastrea heliopora* (Lam.) the primary cycle consists of twelve couples of mesenteries, which may be due to the true secondary couples having grown and met the stomodæum. Most polyps of Group I possess the full number of secondary couples, viz. six; in a few polyps the tertiary cycle is also complete with twelve couples, while quaternary couples of mesenteries have only occasionally been met with, viz. in *Galaxea fascicularis* (Linn.), the cycle itself being quite imperfect. Both Lacaze Duthiers and Faurot have shown that in the Hexactiniæ, while the primary couples are formed in pairs on each side of the sagittal plane, the couples of the subsequent cycles are formed in the exocœles.

In my Group II directive couples of mesenteries are absent, nor is there a sequence of mesenterial cycles as in Group I. The only distinction that could be made between the couples is between those that meet the stomodæum and those that do not reach it; the

* The term "directive" mesenteries ("Richtungssepten") was first employed by the Hertwigs, as they believed that these two couples might be of use in fixing the orientation of an Actinian polyp; Schneider and Rötteken (**114**) had carefully described their arrangement in 1871. Lacaze Duthiers in 1897 (p. 221) doubted the suitability of Hertwigs' terminology, as the two couples in question did not indicate any direction in the polyp.

† McMurrich (**99**, p. 132) suggests that the reverse arrangement of the muscles on the directive mesenteries may have "something to do with the preservation of the lumen of the siphonoglyphe when the lips of the stomodæum elsewhere are in contact."

‡ Faurot and van Beneden use "complete" and "incomplete," not with reference to the couples or pairs, but to the individual mesenteries that either meet the stomodæum or do not reach it. The adjectives "perfect" and "imperfect" have also been used in the same sense.

former I term "principal" couples and the latter "subsidiary" couples. In any species of this group, the number of principal couples varies within narrow limits, while that of the subsidiaries may vary considerably; sometimes the latter may be entirely wanting between two adjacent principal couples. Moreover, some of the principal couples may be incomplete. The subsidiary couples differ irregularly in their radial and vertical extent, some of them being very narrow and short; two mesenteries constituting a subsidiary couple may also differ in their relative size. This variation is no doubt due to the differences in the time of formation of the mesenteries. The number of subsidiary mesenteries in any exocœle is also liable to great variation*.

All the mesenteries are attached above to the oral-disc, and along their outer margins to the corallum, by means of the wedge-shaped mesoglæal processes, but they vary considerably in their depth, the primary and principal mesenteries reaching very nearly to the base of the polyp. The arrangement and structure of the mesenteries, and the numbers of cycles and of the couples composing them are of considerable value in the classification of corals. Following Fowler's terminology (**44**, p. 578), the part of the gastro-vascular cavity included within a couple is known as an "entocœle" ("loge" of French authors) and that between two neighbouring couples as an "exocœle" ("interloge" of French authors).

As the two directive couples and grooves are situated at the ends of the longer diameter of the stomodæum and as the mesenteries are arranged on the hexameral plan, the polyps of Group I are divisible into two similar halves along this plane, viz. the *sagittal* ("plan commissural" of Faurot, p. 59, and "plan médian" of van Beneden, p. 12); they may also be divided into two similar halves along a plane at right angles to the sagittal, viz. the *transversal* ("plan médian" of Faurot). In some polyps the bilateral symmetry is not quite perfect owing to the incompleteness of the last cycle of mesenteries. Typically, however, Group I may be regarded as bilaterally symmetrical along two planes. Their mesenterial couples are also arranged radially with reference to the oro-aboral axis ("axe-vertical" of Faurot, "axe oro-aboral" or "axe du corps" of van Beneden), passing through the centre of the mouth at equal distances from the two directive grooves. Like the couples of mesenteries the disposition of the tentacles may also be assumed to be symmetrical both bilaterally and radially, although from preserved polyps I have not been able to settle this point.

In Group II, on the other hand, the bilateral symmetry is wanting owing to the absence of the directive couples of mesenteries and of the grooves; a trace of the bilateral symmetry is, however, left in the lateral compression of the stomodæum. The radial symmetry is interrupted by the indefinite number and the irregular width of the subsidiary couples of mesenteries and by the incompleteness of some of the principal couples. In *Gyractis*, Boveri (**19**) regarded the absence of directive mesenteries as only apparent, their presence being disguised by the development of a mesentery on either side of each of the two Edwardsian directive couples, but McMurrich (**99**) believed that the disappearance of the directives may be due to "the mesenteries which really represent

* Parker (110) has made similar observations on the numerical variation and on the irregular arrangement of the incomplete mesenteries in the "monoglyphic" forms of *Metridium marginatum*.

them having developed their longitudinal muscles on adjacent faces" (p. 119). Which of these two views is applicable to the forms included in Group II can be determined only after making a comparative study of their development.

Faurot (**40**, **42**) applied the term "couple" to two mesenteries that appear at the same time, one on each side of the sagittal plane, and "pair" to two adjacent mesenteries, which lie on the same side of the sagittal plane, facing each other. According to this nomenclature the twelve primary mesenteries are formed in couples which appear arranged in pairs in the adult, whereas the mesenteries of the succeeding orders are formed in pairs, one pair in each exocœle. In 1900, Bourne (**16**), on the other hand, used these words in exactly the opposite sense; in a footnote on p. 39 he added that "it is convenient when speaking of the adult arrangement of the mesenteries to use the word 'couple,' when of their developmental sequence to use the word 'pair.'" But in 1905 (**17**) he reverted to Faurot's use of "pair." Bourne's original use of "pair and couple" is, however, to be preferred when speaking of forms which are bilaterally symmetrical, and since the Anthozoan polyp is said to have a primary bilateral symmetry, "pair" is to be used to denote the mesenteries that appear on either side of the sagittal plane, and couple when referring to their adult arrangement*. The mesoglæal pleats of the mesenteries are either simple or sub-divided and vary in their shape, size and radial distribution in the different species. In the stomodæal region of the polyp the mesenterial mesoglæa is devoid of entocœlic pleats for a variable distance from its stomodæal attachment. Below the stomodæum, the entocœlic pleats usually become broader and cover nearly the whole of the width of the mesentery. In a few species, *e.g. Favia favus* (Forsk.) (Pl. **4**, fig. 36) and *Echinopora hirsutissima* (Ed. and H.) (Pl. **2**, fig. 20), short exocœlic pleats are present to a short distance from the stomodæal attachments of the primary mesenteries, on which the muscle-strands are better developed; this may perhaps be because the polyps in this species have assumed an oblique position. In the polyps of *Mycedium okeni* Ed. and H. that I have examined the exocœlic pleats are much broader and thicker than the entocœlic ones and extend over the inner half or two-thirds of each principal mesentery, the latter being as a rule restricted to its outer quarter. This peculiarity may be due to the completely horizontal position which the polyps have assumed in that species. The mesoglæa is not of uniform thickness along the entire width of the mesentery.

Though the contraction of the polyps may affect the condition of the mesenterial mesoglæa, I find its characters, viz., relative thickness, the shape, size and distribution of the pleats (both entocœlic and exocœlic), retaining a specific constancy. The Hertwigs and the Actinologists after them attached the same value to the mesoglæal pleats of the oral-disc. The endoderm is usually vacuolated. The vacuoles when definite are either oval or goblet-shaped (Pl. **1**, fig. 4) and, as I have suggested, may be capable of ingesting and digesting food-particles. The endoderm is not usually of even thickness along the entire width of the mesentery. Its relative thickness varies in the different species. Behind the attachment of the mesenterial filament, the endoderm is usually swollen, pad-like in transverse section, and is constricted off from the filament; its two wings were termed

* H. V. Wilson (122) used "pair" with reference to both the developmental history and the adult arrangement of the mesenteries.

"mesenterial lobes" by H. V. Wilson, which he regarded "merely as a device to support the filament" (p. 225).

A short distance below the stomodæum, the margin of each primary mesentery is drawn out into long ribbon-shaped prolongations which, with the filament continued along their free edges, lie coiled together in the gastro-vascular spaces. The free margins of mesenteries which do not meet the stomodæum are also drawn out into such processes. When these processes are cut across they appear as bars of mesenterial tissue, usually curved, with the filament on either side of each bar (Pl. **3**, fig. 30). They are also found extended into the inter-mesenteric spaces of the edge-zone but, as a rule, are scarce in the region above the enterostome, while below it they may be massed together in the gastro-vascular chambers. These convolutions are often found in the peristome, protruded through pores (? artefacts) in its floor (this observation is based on the preserved material); they may also be ejected through the mouth, but this is less frequently the case as in sections I have noticed them in the stomodæa of only *Echinopora* and *Favia ananas* (Ell. and Sol.).

Mesenterial filaments (Pl. **1**, fig. 6 and Pl. **3**, fig. 30). Every mesentery which meets the stomodæum and most of the others bears a filament (the "craspedum" of Gosse and "enteroïde" of Faurot) on the free margin of its straight region and along the entire edge of the coiled ribbon-shaped processes into which the mesenterial margin is prolonged. The filament terminates a short distance from the insertion of the mesentery to the basal disc. The structure of the filament can be best made out in a primary mesentery. It consists of a median part and two lateral extensions (the "main body" and the two "ventro-lateral tracts" of H. V. Wilson), the former is the continuation of an ectodermal ridge of the stomodæum, while the latter arise from the stomodæal ectoderm on each side of the ridge. The lateral extensions lie like two flaps over the mesenterial endoderm to a short distance below the stomodæum (Pl. **1**, fig. 5). The stomodæal ectoderm is also reflected upwards to some distance, this being continuous with the downward lateral extensions referred to. In the region of this upward reflection, the stomodæal endoderm comes to lie between two layers of ectoderm.

The mesoglæa of the stomodæal wall, however, is continued upwards and downwards along with the ectoderm, separating the latter everywhere from the endoderm. The lateral extensions are soon tucked inwards and come to lie behind the median tract. The mesoglæa in the filament then appears T-shaped in transverse section, the handle of the T is the termination of the mesenterial mesoglæa, while the two arms are due to the downward extensions of the stomodæal mesoglæa. The so-called forking of the margin of the mesoglæa is therefore not a case of bifurcation at all. In the earlier sections the filament appears somewhat triangular while, lower down the straight region, it becomes more consolidated and appears hemispherical or almost circular in transverse section. The straight region of the filament is ciliated. The nuclei of the filament are of the same nature as in the stomodæal ectoderm, massed together concentric to the periphery of the filament, incomplete at its base where the mesoglæa enters the filament. In the median part of the filament granular vacuoles are usually present, their granules varying in size.

Nematocysts are restricted to the median region of the filament, usually somewhat scarce in its straight region, but when present may belong to any of the three types previously described; in the coiled region, they occur in large numbers, usually arranged close together in the form of batteries (figs. 17 and 59). Type I is less frequently present than II and III. From histological appearances it seems probable that the straight region takes part mainly in digestion, while the convoluted region is for offensive or defensive purposes. This suggestion may account for the fact that the convolutions are frequently found protruded through the oral-disc and through the stomodæum. On some of the mesenteries that do not reach the stomodæum filaments are rudimentary or even absent.

H. V. Wilson regarded the mesenterial filament of *Manicina* as equivalent to the trilobed filament of an Actinian as described by the Hertwigs, the ventro-lateral tracts corresponding histologically with the lateral ciliated bands ("Flimmerstreifen") and the median portion with the central glandular lobe ("Nesseldrüsenstreif"), whereas according to Duerden an entire coral filament represents only the middle lobe of the trifid Actinian filament and that in the former "there is nothing which corresponds morphologically with the lateral lobes" (**32**, p. 472).

Various views have been held on the origin of the filaments in the Anthozoa. H. V. Wilson in 1889 concluded that the filaments were ectodermal structures, those of the primary mesenteries being extensions of the stomodæal ectoderm along the free mesenterial margins, while those of the incomplete mesenteries were formed by the reflection of the stomodæal ectoderm towards the oral-disc and thence across its inner surface to the free edges of the mesenteries. He further held that the three lobes of an Actinian filament were also ectodermal in origin and suggested that they could be derived from the simpler larval filament of *Manicina*; in the latter the two lateral ciliated tracts and the median secretory tract are already differentiated; "to produce the trifid filament it is only necessary for these tracts to become separated by the division of the mesoderm (=mesoglæa) into three lobes" (**122**, p. 228). E. B. Wilson in 1884 had regarded the "Flimmerstreifen" of the Hertwigs to be ectodermal and homologous with the two longer dorsal filaments of an Alcyonarian, which were downgrowths of the stomodæal ectoderm, provided with long cilia but with no gland cells and functioning as organs of circulation; the same author believed the "Nesseldrüsenstreifen" to be endodermal and homologous with the remaining six shorter Alcyonarian filaments which were thickenings of the mesenterial edges containing gland cells and subserving a digestive function. McMurrich in 1891 disagreed completely from H. V. Wilson's and favoured E. B. Wilson's view. According to him the median tract of a filament of *Aulactinia* was formed first by a differentiation of the endoderm at the free margin of the mesentery while the two lateral lobes were downgrowths of the stomodæal ectoderm*; he further suggested that the same order was followed in the phylogenetic history of the filament. In a later paper, while still maintaining that the median region and the lateral tracts arose independently in ontogeny, he did not regard the ectoderm and endoderm of Coelenterates as having reached in phylogeny a degree of differentiation equal to that of the epiblast and hypo-

* E. B. Wilson's figs. 20 and 23, transverse sections of the embryonic filaments of *Aulactinia*, are similar to those of adult coral filaments.

blast of vertebrates, hence his use of "ectodermal" and "endodermal" was "merely for convenience and not as expressing a definite homology" (**100**, p. 271).

Gardiner in 1899, from a histological study of the filaments of *Cœnopsammia*, also came to the conclusion that they were entirely ectodermal structures, and supported H. V. Wilson's contention based on embryological data; he added further that "the lateral parts of the mesenterial filaments are similar in structure to the 'Flimmerstreifen' of the Hertwigs and have apparently the same function" (**49**, p. 375). Duerden, from his study of West Indian Madreporarian polyps, inferred that their filaments were entirely endodermal, the histological resemblance between them and the stomodæal ectoderm being a secondary feature. His reasons for this view were that filaments were present on incomplete mesenteries which never reached the stomodæum, that the reflected stomodæal ectoderm could not be traced up to the oral-disc and thence to the free edges of the incomplete mesenteries, that in the upper regions of the latter filaments were absent or incipient while they were well developed below, that filaments appeared independently on some of the primary mesenteries before the latter reached the stomodæum. Duerden regarded the "reflected ectoderm" as "the stomodæal ectoderm passing along the mesentery to establish structural continuity with the upwardly growing filament" (p. 479).

The appearances in my sections favour the view of the ectodermal nature of coral filaments held by H. V. Wilson and Gardiner. In *Cyphastrea chalcidicum* (Forsk.) I have found traces of the upwardly reflected stomodæal ectoderm as far as the oral-disc; perhaps this ectoderm might be continued to the secondary mesenteries and finally course down their free margins as their filaments. Of course, questions like these could be settled only by a study of the development of coral larvæ*.

Acontia and cinclides. Conflicting accounts have been given by different authors with regard to the presence or absence of these organs in coral polyps. Fowler in 1884 and Bourne in 1887 at first applied the term acontia to the prolongations of the mesenterial margins in *Flabellum* and *Fungia* respectively, and found them capable of being protruded through permanent openings (cinclides) in the oral-disc, the former author regarding "the contorted mesenterial filaments" of Moseley as identical with the acontia of Gosse; Bourne in 1888 withdrew his application of the term "acontia" to these prolongations. H. V. Wilson could find no free acontia in *Manicina*, but noticed that the filaments which were attached along their whole length to the mesenteries could be extruded through the mouth and through pores in the body-wall. With regard to *Cœnopsammia*, Gardiner remarked that "the filaments are attached to the mesenteries for their whole length, and are without free portions (acontia) at their lower ends" (p. 367), whereas in the Turbinolids he examined in 1904 "the lower ends of the filaments

* Referring to the probable formation of the stomodæum in *Flabellum*, Gardiner says, "The only logical method of conceiving the formation of the stomodæum of the adult to take place is to suppose that the external body-wall grows inwards catching up the edges of the mesenteries in its progress. It finally reaches the mesenterial filaments, which by fusion together, assisted by the down-growth of the body-wall form the stomodæum" (p. 151). My examination of Gardiner's "young polyp" of *Flabellum* (figs. 3 and 4) confirms the facts on which his conclusions are based, viz. that it had no trace of tentacles or stomodæum and that filaments were present on the margins of the mesenteries.

commonly form coiled masses, the **acontia**" (**52**, p. 123). Duerden could see no "cinclides" in the living coral polyps he examined, but observed that the filaments with the contorted edges of the mesenteries could be protruded through the mouth or through temporary openings on any part of the column-wall or oral-disc, but that such extensions were different from the acontia of *Sagartia*.

The term "acontia" was first applied by Gosse to the threads in the *Sagartidæ*, which he found protruded through special openings (which he named "cinclides"), but gave no structural characterization of the threads. They were re-described by the Hertwigs, but the exact relation between their acontia and "mesenterialfäden" (**66**, Pl. 8, figs. 10 and 12) is not evident. Faurot in 1895 remarked that an acontium has "a peu près la même structure histologique que l'enteroïde," and that it was for augmenting the digestive surface of the mesenteries and "non d'être utilisés uniquement comme arme défensive" (**40**, p. 53). In 1897 van Beneden defined them as arising from the mesenteries between the terminations of the mesenterial filaments and the aboral ends of the polyps, and gave as the essential difference between the two structures that while the epithelia of acontia were endodermal, those of the filaments were ectodermal, being continuations of the stomodæal ectoderm. According to Duerden, "acontia (in the Sagartidæ) are thread-like structures, which are but feebly attached to the mesenteries, and pass through permanent apertures (cinclides) in the column wall of the polyps, or through the mouth, the mesenteries in no ways following. If not wholly liberated from the polyp, the acontium can be indrawn. The extruded filaments of corals, on the other hand, still retain their normal position along the contorted edge of the mesentery, and a portion of the latter passes out along with them. The function of both is probably the same, as in each case the organs are strongly charged with nematocysts, and less so with gland cells" (**32**, p. 476).

Is the name "acontia," then, to be restricted to thread-like structures, which are attached by one extremity to mesenteries below the terminations of the filaments and endodermal in structure, and is their presence always correlated with that of "cinclides"? In my coral polyps I have not satisfactorily investigated if among the convolutions of the mesenterial filaments, which are so often protruded into the peristome, there are any threads comparable to the acontia of Sagartidæ.

Reproductive Organs. Mature ova have been seen in many of the polyps examined (Pl. **1**, fig. 10, Pl. **3**, fig. 29, and Pl. **5**, fig. 49). They are carried by all the mesenteries or by the primaries only, forming one to five or six longitudinal rows. The ripe ovum is large, varying in size in the different species, enclosed in a thin vitelline membrane; its cytoplasm is highly vacuolated, the vacuoles being somewhat small and round and the nucleus large, stained pink, excentrically situated, with a dark-stained nucleolus on one side. It lies in the mesoglæa usually on its exocoelic side; the mesoglæa surrounding it is narrowed to a thin membrane, while the mesenterial endoderm over it is usually swollen and granular, perhaps for nutritive purposes.

Surrounding the large ova are frequently seen some small cells which, for reasons given below, I take to be germ-cells. These lie in the mesoglæa or in the surrounding mesenterial endoderm, each consisting of a large spherical nucleus—similar to those of the

calicoblastic layer—containing usually a dark-stained spot and surrounded by a little irregular cytoplasm; sometimes a network may be discerned within the nuclear membrane*.

In two polyps of *Cyphastrea serailia* (Forsk.) certain structures are present in the same position as the ova, which I am led to conclude are mature testes (Pl. **1**, fig. 9). Each of these is circular in transverse section or laterally compressed, and contains innumerable minute triangular-shaped spermatozoa stained dark in iron-hæmatoxylin†. Germ-cells, similar to those surrounding the eggs, are also seen scattered around the testis.

In some female polyps small groups or follicles—round or adpressed—of germ-cells are found to lie in the mesenterial mesoglæa, behind, in front of, or on each side of the large ova; the cells being either massed together or surrounding a space in the centre of the follicle. In a polyp of *Cyphastrea serailia* (Forsk.) (from the same colony from which the male polyps were taken) in which ova were found in three of the primary mesenteries arranged in single rows, germ-cells were present massed together in small follicles and also surrounding the eggs (Pl. **1**, fig. 10). In a polyp of *Cylicia* in which ova were seen in most of the mesenteries in one or more usually two rows, the follicles lay mostly behind the ova, each usually with a space in its centre. In some serial sections of Gardiner's, named *Prionastrea abdita*, ova of varying size were to be seen in most of the mesenteries, arranged in rows up to six or eight, along with as many groups of germ-cells. In another polyp of *Cylicia* a number of such follicles‡ were present in the mesenteries, and occasionally structures resembling the mature testes in *Cyphastrea serailia*; in some of the follicles both germ-cells and spermatozoa appear to be present; no ova could however be found anywhere in this polyp.

From the above observations I am led to make the inference that both ova and spermaries may develop from the same kind of follicles, that an ovum is only one of the germ-cells in a group which has grown at the expense of the others§, in support of which it may be added that small ova were to be found in the midst of a few of the follicles. The cells that invariably surround the ova are, on this suggestion, to be regarded as the remnants of the original follicles (Pl. **5**, fig. 49). Further, the case of *Cyphastrea serailia* suggests that both male and female polyps may occur in the same colony at the same time.

In the case of *Flabellum*, Gardiner regarded such groups as composed of "spermatogens" and a few ova which he noticed along with the follicles as due to protandry

* I have found similar germ-cells surrounding some of the ova in Gardiner's sections of the polyps of *Cœnopsammia* and *Flabellum*.

† The appearance is similar to Ashworth's figure of a spermary of *Xenia hicksoni* (2, p. 245, pl. 27, fig. 33), and to van Pesch's figures of testis-follicles from the mesenteries of *Stichopathes* (111, pl. VII, figs. 2 and 4); the latter author describes the spermatozoa as possessing long tails, and observed them even in the tentacles, but he has not given figures of isolated spermatozoa showing the tails. Lacaze Duthiers figured mature spermatozoa from *Cladopsammia rolandi*, which have a triangular head with a long flagellum proceeding from the centre of its base (92, pl. 11, fig. 7). In the spermatozoa of *Cyphastrea serailia*, perhaps the tail has been lost or has not yet developed.

‡ Professor V. H. Blackman after examining these bodies tells me that they do not show any plant characters and cannot be spores of algæ.

§ Hickson (70) has also made a similar observation of ova developing in groups of cells in *Alcyonium digitatum*.

in the genus. In a later paper (**51**) he further suggested that coral polyps are male when young, becoming female as they get older, that all the members of a colony are either male or female at the same time. I have looked over his sections of *Flabellum* and have found the cell-groups he has described to be identical in appearance with those in the polyps of *Cylicia* and *Prionastrea abdita* already referred to. If Professor Gardiner's suggestion be confirmed, then a species like his *P. abdita* will have to be regarded as hermaphrodite, since ripe ova were present in the same mesenteries along with the testicular masses. If, on the other hand, the bodies I have termed spermatozoa really represent the final stage in spermatogenesis and not simply artefacts*, then the follicles in *Flabellum* would not be testes but groups of primitive sex-cells from which ova were ultimately to develop. Indeed, the stringed arrangement of these groups and of the ova are similar. Fresh ova would develop from these groups as the ripe ones were discharged. When all the possible ova have thus been formed, the follicles would altogether disappear, as happened to be the case in the two largest polyps of *Flabellum* which Gardiner examined. All the remaining polyps which had only the follicles would then be immature females. On such an interpretation none of Gardiner's polyps could be regarded as protandrous†. However, on questions like these, no definite conclusions are possible till fresh polyps are actually examined.

The similarity between the nuclei of the germ-cells described above and those of the calicoblastic layer of ectoderm has already been noted. Around some of the calicoblast-nuclei a thin coat of cytoplasm appears to be differentiated. Certain appearances further suggest that these cell-elements migrate into the mesenterial endoderm and ultimately into the mesoglæa to form the above-mentioned follicles‡. If so, this phenomenon, together with some of my observations on the possible migration of nematocysts from the ectoderm into the endoderm, will have considerable theoretical importance§.

Zooxanthellæ (Pl. **1**, figs. 1, 4, and Pl. **6**, fig. 51, etc.). All the polyps I have examined contain the so-called zooxanthellæ in greater or less abundance, but they are invariably restricted to the endodermal layer. Each of these algæ is round, the protoplasm staining pink, the nucleus excentrically placed and granular in appearance. In addition, there is, in most algæ, a homogeneously dark-stained body—in all probability a pyrenoid—with a transparent ring round it. Algæ are most abundant in the edge-zone and the peristome, often completely filling the endoderm, and to a less extent in the tentacles, *i.e.* in the exposed regions of the soft parts. In a species like *Galaxea musicalis*, in which the stomodæum seems to be imperfectly functional, the zooxanthellæ are most numerous. This fact may be taken as an additional indication of the symbiotic nature of these algæ. In the mesenteries they are more numerous in the non-pleatal than in the pleatal sides, which may be accounted for by the action of the strong musculature on the pleatal sides.

* The definite shape of these bodies and their massed arrangement in the mesenterial mesoglæa (in exactly the same position as the ova) do not warrant their being regarded as artefacts.

† Duerden's account of the gonads in the West Indian coral species which he studied is practically the same as Gardiner's, but he thinks that ova are developed first and spermaria later. His Pl. 20, fig. 140, is similar to the cases I have recorded.

‡ Boulenger (**10**) has traced the origin of sex-cells in craspedote medusæ to interstitial cells of the ectoderm.

§ The sex-cells in coral polyps have hitherto been regarded as arising from the endoderm.

III. CLASSIFICATION

Gemmation and Fissiparity. The use of these terms is in a state of great confusion in coral literature. This is due to workers on the hard parts trying to set up artificial distinctions between genera and species with regard to the exact mode of multiplication of their corallites. In this way various types of budding have been enumerated, viz., marginal, apical, intra-calicular, stolonal, cœnenchymal, etc., all of which can be grouped under two heads, viz., (1) *intra-calicinal budding, i.e.* budding inside the calyx; and (2) *extra-calicinal budding, i.e.* budding outside the calyx. The latter is easy to see, while the former can hardly be distinguished from fission. Olgivie admits that intra-calicinal budding appears like fission, but adds that "fissiparity is simply a hastened development of buds under certain conditions and at certain periods of "vegetative growth" in the life of the coral (**108**, p. 165).

Duerden recognises the value of the different types of intra-calicinal budding, but distinguishes them all from fission, by which term he understands complete stomodæal division into two equal or unequal parts (**32**, p. 513). I have searched in vain among his many figures for one representing a stomodæum in the actual process of division, a phenomenon which I have not found in any of my polyps*. Moreover, Duerden maintains that there is a sharp morphological distinction between budding and fission, that in gemmiferous corals the polyps which arise as buds pass through the same stages as those that develop directly from larvæ and ultimately possess two directive couples of mesenteries and a cyclical hexameral arrangement of the mesenteries, whereas the products of fission in fissiparous genera have neither the directive couples nor the cyclical arrangement. Exceptions are made in the cases of *Porites* and *Acropora* (*Madrepora*), in which fission does not deprive the polyps of directives nor of the cyclical disposition of the mesenteries. Later the same author uses the term "fissiparous gemmation" to denote occasional cases of fission in gemmiferous genera like *Cladocora*, *Stephanocœnia*, and *Solenastrea*, in which he noticed that the fission products of certain large polyps, possessing more than six couples of mesenteries in each of the two mesenterial cycles, retained the two directive couples and the normal hexameral arrangement. On this phenomenon he remarks: "I conceive that gemmation may occasionally take place at almost any part of the free polypal wall, from the disk as well as from the column-wall; and, if within the disk, then also around the oral aperture. In this last case the one mouth and stomodæum would be common to the bud and to the parent; the mesenteries of the one would intermingle with those of the other; two additional pairs of directives would be developed, as in all other buds; and the mesenteries as a whole would have the same ordinal and cyclic value as in buds arising on the column-wall. When the bud reaches its full size, it will tend to separate from its parent, and in so doing it will appear as if an enlarged polyp were undergoing fission into equal halves, whereas, strictly speaking, it is the components of the bud-polyp separating from the parent body" (**35**,

* On p. 493 Duerden says that he has not actually observed the division of the mouth or stomodæum in any of his polyps.

pp. 152 and 153). Later he adds that in fissiparous gemmation "the division of the stomodæum has not the same significance as in true fissiparity. It is rather a separation of two distinct stomodæa, one belonging to the parent and one to the bud; whereas, in true fission, it is the division of an enlarged stomodæum into halves, and neither represents a distinct individual."

From this it is evident that Duerden's original ideas of fission and budding did not fit in with certain facts that were observed later, and as a consequence he had to modify them to such an extent that the processes came to merge into each other as far as his ultimate results are concerned. Moreover, in some of my species in which extra-calicinal budding is the commoner method of asexual reproduction, *e.g. Favia versipora* (Lam.) and *Favia wakayana* (Gard.), directive mesenterial couples are absent, and hence it follows that even true gemmation need not always be followed by the presence of directives and the regular cyclical arrangement of the mesenteries.

Whatever may be the exact morphological changes involved in the two processes, in this paper "gemmation" is used to denote the development of a polyp outside the tentacular ring of its parent, viz. from the edge-zone or cœnosarc, the new individual being a new growth and hence termed a "bud." "Fissiparity" signifies the formation of fresh polyps inside the tentacular ring, viz. in the oral-disc area of an older polyp, the former being only parts of the latter separated off. Following this distinction all extra-calicinal buds would be true buds, while the various types of intra-calicinal buds would be regarded as fission-products.

The presence of two couples of directive mesenteries is invariably associated in my polyps with two types of symmetry, viz. (1) *bilateral symmetry*, along two vertical planes, indicated by the lateral compression of the stomodæum, by the presence of a directive groove and by a directive couple of mesenteries at each end of its longer axis; (2) *hexameral symmetry*, shown by each of the alternating mesenterial cycles consisting of six couples or of a multiple of six.

Conversely the absence of the directive couples is marked by the disappearance of the two symmetries, the only distinction in the arrangement of the mesenterial couples being between those which meet the stomodæum and those that do not reach it.

In the fission-products of the genera I have studied the stomodæum appears to arise in two ways: (1) as an invagination of the oral-disc* of another polyp, *i.e.* as an independent structure secondarily effecting a communication with the gastro-vascular cavity, *e.g.* in *Favia abdita* (Ell. and Sol.); (2) as a diverticulum from a parent stomodæum which grows towards the oral-disc and opens to the exterior, as is probably the case in *Goniastrea pectinata* (Ehrb.).

In the case of either of the two processes I have suggested, some of the mesenterial couples of the old polyp would secondarily become attached to the stomodæum of the new individual, and to the latter would come to belong also the tentacles which arose from the chambers between such mesenteries.

Astræidæ with distinct corallites. Duerden bases his classification of the *Madreporaria* upon what he considers to be two distinct types of mesenterial succession (**32**,

* This process is somewhat similar to the stomodæal formation in *Flabellum* as conceived by Gardiner.

pp. 535—541). According to him, "the young polyps of both gemmiferous and fissiparous genera are built upon exactly the same plan" (p. 539), viz., with the full complement of primary mesenteries ("protocnemes") which, in both cases, are formed as "bilateral pairs," *i.e.* the two members of a pair arise, one on each side of the median axis, with the "retractor muscle" turned towards the same aspect of the polyp, but that the succeeding mesenteries ("metacnemes") arise in two ways; in the first group ("Entocnemaria," including only two genera *Porites* and *Madrepora*) they arise in "bilateral pairs," as the primaries, but only "within one or both of the directive entocoeles," whereas in the second group ("Cyclonemaria," including the Astræidæ, Oculinidæ, and Fungidæ) they arise as "unilateral pairs," *i.e.* the two members arise in the same exocœle, their retractor muscles being *vis-à-vis*. The family Astræidæ is divided into two sub-families, Gemmantes and Fissiparantes.

Such a division of the Astræidæ is based upon the author's theories regarding budding and fission, but from the above it is evident that the polyp symmetries are not necessarily dependent upon those two processes. Whatever may be the factors governing the symmetries, the presence or absence of two directive couples retains a constant morphological value in all the species and genera I have studied, and hence possesses an importance in classification over and above any physiological phenomena like budding and fission.

I have accordingly divided my genera into two groups, characterised (I) by the presence of two couples of directive mesenteries and consequently possessing both the bilateral and hexameral symmetries, and (II) by the absence of the directive couples, and hence of the symmetries.

Boveri (**19**) for *Gyractis* and Kwietniewski (**88**) for *Thalassianthus* regarded the absence of directive mesenteries as of ordinal value, creating the Holactiniæ and Thalassianthæ for their reception. On the other hand, McMurrich (**99**) did not regard their absence as having any phylogenetic significance, but viewed it as "a peculiarity which is essentially individual, possibly rising secondarily in some cases to the value of a specific or even a generic character...." (p. 121).

From an examination of the sections of the coralla of the following genera I am led to infer that in Group I the septa are not directly continuous from corallite to corallite, the peritheca filling the inter-corallite spaces; if any such septal continuity is seen, as in *Diploastrea heliopora*, it appears to be due to a secondary rearrangement of the calcareous elements of the peritheca. When two adjacent corallites are in contact, their walls are still distinct, the costæ of one fitting in between those of the other. On the other hand, in Group II the septa of neighbouring corallites are usually continuous, the continuity being primary.

In all these genera the corallite-wall appears to be formed by the union of the outer thickened parts of the septa, *i.e.* is a pseudotheca. In *Galaxea* a "eutheca," as described by Ogilvie, is not seen in my sections*; the wall in this genus is also composed of the thickened peripheral parts of the septa, with the lines of suture quite distinct between

* On the supposition of a true theca in *Galaxea*, Ogilvie separated this genus from the Astræidæ and placed it provisionally in a new family, *Stylinidæ* (p. 162).

them ; I have not made out any "wall-lamellæ" between the peripheral parts of the septa (see **108**, p. 159). On the other hand, such lamellæ, *i.e.* interseptal tangential bridges with dark lines, are seen in the transverse sections of the coralla of certain species of *Favia, e.g. F. doreyensis* and *abdita,* while they are absent in allied species. It would appear from these observations that no great importance could be given to the dark-centres and lines.

Summary of characters. The main characters that I have made use of in the determination of genera and species, so far as the polyps are concerned, are as follows :

I. *Oral-disc and Edge-zone.* (1) The nature and relative thickness of the ectoderm and endoderm.

II. *Tentacles.* (2) The presence or absence of either entocœlic or exocœlic tentacles or of both.

(3) The presence or absence of sub-terminal batteries ; when present, the number of the batteries constituting a longitudinal row.

(4) The nature of the ectoderm and endoderm.

III. *Stomodæum.* (5) The nature of the ectodermal ridges at the attachments of the primary mesenteries—their relative breadth and thickness.

IV. *Mesenteries.* (6) *In Group I,* the number of mesenterial cycles and of the couples constituting each cycle ; in *Group II,* the approximate number of couples in the principal and the subsidiary cycles.

(7) The shape, relative size and distribution of the entocœlic mesoglæal pleats, the presence or absence of exocœlic pleats, and the relative thickness of the mesenterial mesoglæa.

(8) The nature and relative thickness of the mesenterial endoderm.

(9) The extent to which the margins of mesenteries are convoluted.

V. *Nematocysts.* (10) The nature, distribution and relative abundance of the types present.

If the reliability of the above characters should be doubted on the ground of their dependence on the degree of contraction, preservation, etc., of the polypal tissues, it is only necessary to refer to the case of species like *Goniastrea retiformis* (Lam.) and *Leptastrea roissyana* (Ed. and H.) whose specific characters have remained constant in spite of their wide distribution. There was abundant material of *G. retiformis* from the Maldives, Funafuti, Fiji and Ceylon, of *L. roissyana* from the Red Sea and Ceylon, and of *Favia abdita* from the Maldives and Ceylon, collected by different persons at different times and perhaps also treated differently. In either case the transverse sections of the polyps from these remote localities presented the same appearance, the specific characters being easily recognisable from any one of them. In the case of species with limited distribution, the constancy of the specific characters is maintained in polyps taken from different colonies.

Since the condition of the polypal tissues can be easily judged from the sections, the characters of well-preserved polyps may be relied on as normal. Under every species

described in this paper, mention is made of the histological condition of the polyps sectioned.

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Key to Genera based on Polyps.

I. Two directive couples of mesenteries present; mesenterial couples with hexameral cyclical arrangement ... ... *Group I.*

A. Six couples of mesenteries meeting stomodæum; mesenterial mesoglæa not much thickened.

a. Stomodæum well formed, entocœlic pleats of mesenteries undivided; mesenterial endoderm usually swollen.

i. Two cycles of mesenteries, each of six couples; nematocysts (III) rarely present ... ... *Cyphastrea.*

ii. Three cycles of mesenteries, the first two of six couples each and the last of twelve couples; nematocysts (III) numerous but narrow, and without any central core ... ... *Echinopora.*

b. Stomodæum not well formed, often much compressed laterally and distorted; entocœlic pleats of mesenteries sometimes or frequently sub-divided; mesenterial endoderm thin.

i. "Ovoid bodies" present; numerous sub-terminal tentacular batteries ... ... *Galaxea.*

ii. "Ovoid bodies" absent; up to five sub-terminal tentacular batteries ... ... *Leptastrea.*

B. Twelve couples of mesenteries meeting stomodæum; mesenterial mesoglæa much thickened ... ... *Diploastrea.*

II. Directive couples of mesenteries absent; mesenterial couples without any cyclical arrangement ... ... *Group II.*

A. Number of principal couples of mesenteries indefinite; subsidiary couples less than thrice the number of principal couples; nematocysts II and III typical *Favia.*

B. Not more than six principal couples of mesenteries; subsidiary couples more than thrice the number of principal couples; nematocysts II and III narrower, in II, axis shorter... ... ... *Goniastrea.*

Key to Genera based on Corallum.

I. Corallites formed by extra-calicinal budding; septa with or without cyclical arrangement, number meeting columella more or less definite ... *Group I.*

A. Corallite-walls imperforate.

a. Perithecal spines often present.

i. Corallites small and vertical; costal and perithecal spines when present not high, their bases never fused; not more than twelve septa (*i.e.* no tertiaries) meeting columella ... ... *Cyphastrea.*

ii. Corallites usually large and oblique. Costal and perithecal spines conspicuously high, their bases often fused to form perithecal ridges; more than twelve septa (*i.e.* a varying number of tertiaries also) meeting columella ... *Echinopora.*

b. Perithecal spines absent.

i. Peritheca highly vesicular; corallites usually projecting far above peritheca with markedly exsert septa; inter-corallite furrows absent ... ... *Galaxea.*

ii. Peritheca dense; corallites level or slightly projecting, with septa little exsert; polygonal inter-corallite furrows present ... ... *Leptastrea.*

B. Corallite-walls perforate ... ... *Diploastrea.*

II. Corallites usually formed by fission, sometimes by budding; septa without cyclical arrangement, number meeting columella indefinite ... *Group II.*

A. Corallite-walls usually separated by perithecal regions of varying thickness; septa not of equal width at calicular margins; an alternating cycle of rudimentary septa absent or present ... ... *Favia.*

B. Corallite-walls fused; septa of equal width at calicular margins; an alternating cycle of rudimentary septa present ... . *Goniastrea.*

IV. SYSTEMATIC. GROUP I.

Genus *Cyphastrea*, Klunzinger.

1816. *Astrea* (pars), Lamarck, Hist. anim. sans vert., ii, p. 257.
1834. *Explanaria* (pars), Ehrenberg, Korall. roth. Meer., p. 82.
1834. *Favia* (pars), Ehrenberg, Korall. roth. Meer., p. 93.
1848. *Astræa*, subgen. *Orbicella* (pars), Dana, Expl. exp. Zooph., p. 205.
1848. *Cyphastrea*, Milne Edwards and Haime, Compt. rend. l'Acad. Sci., xxvii, p. 494.
1848. *Solenastrea*, Milne Edwards and Haime, Compt. rend. l'Acad. Sci., xxvii, p. 494.
1857. *Cyphastræa* (pars), Milne Edwards and Haime, Hist. nat. Corall., ii, p. 484.
1857. *Solenastræa*, Milne Edwards and Haime, Hist. nat. Corall., ii, p. 495.
1879. *Cyphastræa*, Klunzinger, Korall. Roth. Meer., p. 50.
1884. *Solenastræa* and subgen. *Cyphastræa*, Duncan, Journ. Linn. Soc. London, Zool., xviii, p. 107.
1886. *Cyphastræa*, Quelch, Reef Corals, Challenger Reports, Zool., xvi, pt. xlvi, p. 106.
1889. *Cyphastræa*, Ortmann, Steinkorall. Sud. Ceylons, Zool. Jahrb., iv, p. 529.
1899. *Cyphastræa*, Gardiner, Proc. Zool. Soc. London, p. 761.
1904. *Cyphastræa*, Gardiner, Fauna Geogr. Maldives and Laccadives, ii, p. 778.

Corallum. Growth-form variable, mainly incrusting, following any irregularities on surface of attachment, often raised into hillocks, sometimes rounded off and free, usually bored into by various marine animals. Peritheca with dissepiments varying considerably in thickness, spines present or absent. Corallites circular, touching or to 4 mm. apart, level with general surface or to 2 mm. high. Calices to 2·5 mm. in diameter. Three orders of septa: a primary entocœlic, a secondary entocœlic and a tertiary entocœlic, consisting of 6, 6 and 12 septa, sometimes fewer. Tertiaries very narrow, costæ present or sunk in peritheca. Columella formed of trabeculæ from septal margins.

In colonies with uneven surface, corallites in valleys almost touching one another and hardly projecting, but septa more exsert than on hillocks.

Giant corallites* occasionally present, 2·5—3 mm. in diameter, with from sixteen to twenty septa meeting columella (Pl. **12**, fig. 2).

Polyps. Small, average height 2·5 mm. and width 1·25 mm., bearing distinct edge-zones. Mesenteries constituting two cycles, each typically of six couples, number of secondaries sometimes incomplete. Primaries with filaments, secondaries with or without rudimentary filaments. Tentacles of six entocœlic primaries, six entocœlic secondaries and twelve exocœlic tertiaries†. Every tentacle with a terminal battery, sub-terminal ones present or absent. Stomodæum oval, with two siphonoglyphes; its ridges not well developed, broader than thick. Entocœlic pleats of primary mesenteries variable in size and shape. A single ripe gonad on each primary mesentery. Genus comparatively homogeneous. Multiplication by budding.

Duchassaing and Michelotti's‡ three species—*Chypastrea oblita*, *Solenastrea ellisii* and *Solenastrea micans* do not appear to belong to the present genus; in the figure (Pl. IX, fig. 10) of the last species the corallites are over 6 mm. in diameter, and more than twelve septa meet the columella.

A small specimen from Mactan Island, referred by Quelch to *Cyphastrea pleiades*, is, unlike *Madrepora pleiades*, Ell. and Sol., an undoubted *Cyphastrea*, but owing to its worn condition it is impossible to make out its specific characters.

Distribution. Red Sea, Indian and Pacific Oceans.

1. *Cyphastrea serailia* (Forskål). (Pl. **7**, fig. 4; Pl. **11**, figs. 1—9; Pl. **13**, fig. 8; Pl. **38**, figs. 1 and 5.)

1775. *Madrepora serailia* (pars), Forskål, Descr. anim. in Itin. Orient., p. 135.
1834. *Favia microphthalma*, Ehrenberg, Corall. roth. Meer., p. 93 (non *Astrea microphthalma*, Lamarck).
1850. *Cyphastrea? bottæ* (pars), Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 115.
? 1850. *Solenastrea sarcinula*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 122.
1857. *Cyphastræa bottai*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 486.
? 1857. *Solenastræa sarcinula*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 497, D 6, figs. 2*a*—*c*.
1877. *Cyphastræa capitata*, Studer, Monat. Ak. Wiss. Berlin, p. 639.
1879. *Cyphastræa incrustans*, Klunzinger Korall. Roth. Meer., iii, p. 53 (non *Madrepora incrustans*, Forskål).
1904. *Cyphastræa forskœlana*, Gardiner, Fauna Geogr. Maldives and Laccadives, ii, p. 778.
1907. *Cyphastrea forskaliana*, Vaughan, Proc. U.S. Nat. Mus. Washington, xxxii, p. 253, pls. 19, 20, figs. 1 and 2, 22, figs. 1—3.

Corallum. Incrusting or raised into humps. Peritheca vesicular with a few low rough scattered spines, walls of vesicles thin. Corallites 1—3 mm. apart, projecting about ·75 mm., rarely 2 mm. Calices 1·5—2·5 mm. in diameter, interior somewhat obscured owing to thickness and spinous nature of septa. Septa somewhat exsert, sides with low pointed spines, inner margins with short teeth, first two orders sloping obliquely to meet columella; secondaries generally thinner than primaries. Costæ not prominent. Columella finely trabecular with short upright rods projecting into calyx.

Polyps. (1) Secondary entocœlic tentacles absent. (2) Sub-terminal batteries absent from all tentacles. (3) Entocœlic pleats extremely narrow and blunt, not

* See Jeffrey Bell "On the variations observed in large masses of Turbinaria," *Jour. Roy. Micr. Soc.*, 1895, pp. 148—9.

† *C. seralia* is an exception as it has no secondary entocœlic tentacles.

‡ Mémoire Corall. Antill., Turin, p. 77 (1860).

extending over more than the outer two-thirds of width of primary mesenteries, best seen in second quarter from skeletal attachment ; mesoglæa much thicker than in non-pleatal region. (4) In outer two-thirds of width of primary mesenteries (in stomodæal region of polyp) endoderm consisting of large goblet-shaped vacuoles massed together, in inner one-third a non-saccular layer. (5) Endoderm over stomodæum thin. (6) Filaments absent from secondary mesenteries.

Remarks. A. *Polyps.* The terminal batteries cover the greater part of the exocœlic tentacles, but they are small and restricted to the ends of the entocœlic tentacles ; the nematocysts in these are practically all of type I, each with from twenty-five to thirty turns of the spiral ; owing to the comparative fewness the nematocysts' terminal batteries not swollen. Ectodermal muscle-fibres with a longitudinal disposition are visible in entocœlic tentacles. The stomodæal ridges are thicker than broad. The convolutions of the mesenteries are massed together in the inter-mesenteric chambers and extending down to the base of the polyps. Brown sacs suggesting mucous contents are numerous in the coils of the mesenterial filaments, appearing above as clusters of round vacuoles, lower becoming oval and arranged around a common protoplasmic mass containing nuclei at its outer margin ; each has a deeper stained spot in its bluntly-pointed inner end (Pl. **1**, fig. 7). Only nematocysts II are found in the filaments. The endoderm is stained brown in hæmatoxylin and eosin except at the base of polyps, thickened and lobulated in the entocœlic tentacles owing to the presence of large vacuoles ; it is thin in the entocœlic tentacles and in the non-pleatal region of the primary mesenteries ; below the enterostome the mesenterial endoderm is a thin layer on either side of the mesoglæa ; in the upper two-thirds of the secondary mesenteries there are endodermal vacuoles as in the primaries. A circular layer of endodermal muscle-fibres is distinctly seen in the oral-disc. Gonads were observed only in the primary mesenteries. In a male polyp each directive mesentery had a single large testis consisting of a mass of mesoglæa with developing spermatozoa embedded (Pl. **1**, fig. 9), in the other primaries the testes were smaller. They were also met with in the longitudinal sections of another polyp. In a female polyp, taken from the same colony, ripe ova were found in three of the mesenteries in single rows.

Polyps examined, seven, all from a colony from Hulule, Maldives.

B. *Corallum.* In the Copenhagen Museum there are seven of Forskål's originals of *Madrepora serailia* from Rôde Hav. Of these six (the largest measuring $16 \times 12{\cdot}51 \times 2$ cm.) constitute one species for which I retain Forskål's specific name, my type specimens agreeing with them in every respect ; many of the corallites have the six primaries thicker than the six secondaries and twelve prominent costæ, those of the former being somewhat more conspicuous than those of the latter (Pl. **11**, figs. 4—9).

Of the two specimens in the Paris Museum from the Red Sea referred by Milne Edwards and Haime to *Cyphastrea bottai*, the larger ($24 \times 23 \times 19$ cm.) comes nearest the present species but the calices are somewhat larger, up to 3 mm., average about 2·5 mm. ; the specimen itself is somewhat rubbed, especially the corallites on its upper part. *Solenastrea sarcinula* is represented by the very small figured specimen ($4{\cdot}5 \times 3$ cm.), its only difference from *C. serailia* consisting in the higher projection of the corallites, about

3 mm. Two large specimens (25·5 × 14 × 13 cm.) from the Red Sea, named *Solenastræa chalcidicum*, are identical with my examples of *C. serailia*.

Ehrenberg's type of *Favia microphthalma* is a small specimen (6 × 6 cm.) with short hillocks, greatly resembling the present species, its septa have rough sides, the primaries being often thicker than the secondaries, both orders meeting the columella (Pl. **38**, figs. 1 and 5). A specimen (13 × 13 cm.) of the "Gazelle" expedition from New Hanover, referred by Studer to his new species *Cyphastræa capitata* resembles the present species in most respects. Similar to this is another small specimen (8 × 6 cm.), badly cleaned, from "Meermaidstrasse," N.W. Australia, which Studer referred to *C. microphthalma* (Lam.). Marenzeller has already pointed out Klunzinger's error in regarding *Madrepora incrustans* (Forsk.) as a *Cyphastrea*, and has identified Forskål's original to be a *Turbinaria*.

Localities. Red Sea (3)*. Maldives, Hulule (2). Amirante, 16 fms. (1), 30 fms. (1). Saya de Malha, 20 fms. (1), 26 fms. (1). Also from New Hanover and N.W. Australia (Studer), and French Somaliland (Vaughan).

2. *Cyphastrea chalcidicum*, Klunzinger (Pl. **7**, figs. 1, 5; Pl. **12**, figs. 1—3; Pl. **14**, fig. 1).

1775. *Madrepora chalcidicum*, Forskål, Descr. Anim. in Itin. Orient., p. 136.
? 1848. *Astræa (Orbicella) ocellina*, Dana, Expl. exp. Zooph., p. 218, pl. 10, fig. 10.
? 1848. *Astræa (Orbicella) microphtalma*, Dana, Expl. exp. Zooph., p. 217, pl. 10, fig. 11.
1850. *Solenastrea hemprichiana*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 121 (non *C. hemprichana*, Gardiner).
? 1850. *Solenastrea bournonii*, Milne Edwards, and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 121.
1850. *Solenastrea bowerbankii*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 122.
1850. *Solenastrea gibbosa*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 122.
1857. *Cyphastræa ? ocellina*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 487.
1857. *Cyphastræa ? danai*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 487.
1857. *Solenastræa hemprichana*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 495.
1857. *Solenastræa gibbosa*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 496.
1857. *Solenastræa bowerbanki*, Milne Edwards and Haime, Hist. Nat. Corall., ii. p. 498.
1879. *Cyphastræa chalcidicum*, Klunzinger, Korall. Roth. Meer., iii, p. 53, pl. 5, fig. 8; pl. 10, figs. 11 *a—c*.
1886. *Cyphastræa brueggemanni*, Quelch, Reef Corals, Challenger Reports, Zool., vol. xvi, pt. xlvii, p. 107, pl. 4, figs. 4—4*a*.
1899. *Cyphastræa savignyi*, Gardiner, Proc. Zool. Soc. London, p. 761, pl. 49, fig. 1 (non *Cyphastræa savignyi*, Milne Edwards and Haime).
1901. *Cpyhastræa ocellina*, Studer, Zool. Jahrb., xl, p. 402, pl. 30, fig. 10.
1904. *Cyphastræa savignyi*, Gardiner, Fauna Geogr. Maldives and Laccadives, ii, p. 779.
? 1907. *Cyphastrea ocellina*, Vaughan, Recent Madreporaria of the Hawaiian Islands and Laysan, U.S. Nat. Mus., Bull. 59, p. 103, pl. 25, figs. 4, 5, 5*a*, pl. 26, fig. 1.

Corallum. More or less rounded and completely covered with corallites, or raised into hillocks. Peritheca vesicular in parts, with scattered blunt spines, walls of vesicles somewhat thicker than in *C. serailia*. Corallites about 1 mm. apart, in some places level with general surface, maximum projection 1 mm., walls thin. Calices usually about 2 mm. in diameter, deeper than in last species, clearly visible owing to comparative thinness and smoothness of septa. Septa more exsert than in *C. serailia*, sides slightly rough or smooth, marginal teeth slender and spinous, in some cases approaching condition found in *C. suvadivæ*; primaries usually as thin as secondaries, both orders reaching columella.

* The numbers in brackets refer to the numbers of specimens examined from each locality.

Costæ prominent, with short spines. Columella openly trabecular, intermediate between *C. suvadivæ* and *C. serailia*, rods hardly visible.

Polyps. (1) Secondary entocœlic tentacles present. (2) Each tentacle with three or four sub-terminal batteries. (3) Entocœlic pleats somewhat constricted at their bases, arranged close together, best developed in the outer half of width of primary mesenteries; pleatal region of mesoglæa thinner than in *C. serailia*. (4) Endoderm thickening considerably from skeletal attachments of primary mesenteries to stomodæal attachments of same. (5) Endoderm over stomodæum thick. (6) Rudimentary filaments on secondary mesenteries.

Remarks. A. *Polyps.* Both granular and mucous vacuoles are abundant in the ectoderm of the oral-disc and edge-zone; sometimes the granules appear scattered in the ectoderm; between batteries granular vacuoles are conspicuous. Nematocysts I are closely packed in all the batteries; a few II*b* ones are also present in the terminal batteries; only nematocysts II and III have been observed in the mesenterial filaments, some of the latter with partly discharged threads. The stomodæal ridges are somewhat more thickened than in *C. serailia*. The endoderm is more vacuolated than in that species, especially in the tentacles and primary mesenteries; it is comparatively thin in the oral-disc, edge-zone and upper half of the column-wall. Below the enterostome the mesenterial endoderm is four or five times thicker in the inner half of the mesentery than in the outer half, where the protoplasm is reduced to mere strands. Ova were present in one polyp.

Polyps examined, eight: three* from one specimen, three from a second specimen (both Red Sea), two† from a third specimen (Ceylon).

B. *Corallum.* Forskål's original of *Madrepora chalcidicum* is missing from the Copenhagen Museum. I have retained his specific name, since it is not used for any other species of corals and since my type specimens are similar to Klunzinger's figured example (9×6 cm.) of *Cyphastrea chalcidicum*.

Milne Edwards and Haime have referred three large specimens from the Red Sea to *Solenastræa hemprichana* (two of them measuring $23 \times 15 \times 14$ cm. and $21 \times 18 \times 13$ cm. respectively), resembling specimen no. 5 on p. 46; many of the corallites are arranged close together and project like cylinders, a few of them being giant ones; only in a few corallites do all the secondaries meet the columella. These authors have assigned seven specimens from the Red Sea to *Solenastræa gibbosa*, three of them being large ($23 \times 15 \times 14$ cm., $20 \times 10 \times 10$ cm. and $14 \times 14 \times 5$ cm.), which are identical with many of my examples of *C. chalcidicum*. Another specimen from the Red Sea named *Solenastræa chalcidicum* also comes here. *Solenastræa bournoni* is represented by four small specimens from Antilles (the largest measuring only 9×9 cm.), approaching the present species; a few giant corallites are present on them. *Solenastræa bowerbanki*, Ed. and H., is missing from the Paris museum; judging from Milne Edwards and Haime's description it comes

* One of these is a giant-polyp with twelve couples of primary and eight of secondary mesenteries, the former bearing ova.

† In these polyps the stomodæum was less wide, its wall being deeply grooved at the mesenterial attachments. The entocœlic pleats were somewhat thinner. These differences are due to the sudden shrinkage of the tissues, as doubtless the specimens were not fixed or preserved properly.

under the present species. A large specimen from Koseir (Red Sea), named *C. serailia* by Klunzinger, belongs to the present species.

Quelch's new species, *C. brueggemanni*, is represented by a single small specimen (4·5 × 4 cm.) from Mactan Island, Philippines, in which the primary and secondary septa are similar, both orders meeting the columella; a giant corallite is present with eighteen septa meeting the columella. From his description it might be inferred that he had more than one example of the species. Another small badly cleaned specimen, from the same locality referred by Quelch to *C. microphthalma* (Lam.) also appears to belong to *C. chalcidicum*.

Studer's figure of *C. ocellina* agrees with Klunzinger's figure of *C. chalcidicum*, but I have not been able to examine the original. The identity of Vaughan's examples of *C. ocellina* with the present species is somewhat doubtful, since in his Pl. XXV, fig. 5 *a*, the septa appear thicker and rougher than in my specimens, in this respect approaching more the condition in *C. serailia*.

Localities. Red Sea (5). Maldives, Goidu (4). Chagos, Salomon (2). Singapore (2). Ceylon (1 small). Rotuma (1). Also from Antilles (Milne Edwards and Haime), Philippines (Quelch), Laysan (Studer), Sandwich Islands (Dana), Hawaiian Islands (Vaughan).

3. *Cyphastrea microphthalma* (Lamarck) (Pl. **7**, fig. 6; Pl. **12**, figs. 4—9; Pl. **13**, figs. 1, 2, 7; Pl. **34**, fig. 4).

1775. *Madrepora serailia* (pars), Forskål, Descr. Anim. in Itin. Orient., p. 136.
1797. *Madrepora interstincta*, Esper. Fortz. Pflanz., p. 10, pl. 34, figs. 1—3 (non *Madrepora interstincta*, Linnæus).
1815. *Astrea interstincta*, Oken, Lehrb. Naturg., i, p. 66.
1816. *Astrea microphthalma*, Lamarck, Hist. Amin. sans vert., ii, p. 261—2e édit., p. 408.
1834. *Explanaria galaxia*, Ehrenberg, Corall. roth. Meer., p. 82 (non *Astrea galaxea*, Lamarck).
1850. *Cyphastrea microphthalma*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., x, pl. 9, figs. 5, 5*a* and *b*, xii, p. 114.
1850. *Cyphastrea savignyi*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 116.
1850. *Solenastrea forskaliana*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 123.
1851. *Cyphastrea mülleri*, Milne Edwards and Haime, Pol. foss. terr. paleoz., etc., p. 100.
1857. *Cyphastræa microphthalma*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 485.
1857. *Cyphastræa savignyi*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 485.
1857. *Cyphastræa muelleri*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 486.
1857. *Solenastræa forskælana*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p 497.
1879. *Cyphastræa savignyi*, Klunzinger, Korall. Roth. Meer., iii, p. 51, pl. 5, fig. 7.
1879. *Cyphastræa serailia*, Klunzinger, Korall. Roth. Meer., iii, p. 52, pl. 5, fig. 4 and pl. 10, figs. 12*a* and *b*.
1886. *Cyphastræa aspera*, Quelch, Reef Corals, Challenger Reports, Zool., vol. xvi, pt. xlvi, p. 107, pl. 4, figs. 3—3*a*.
1904. *Cyphastræa microphthalma*, Gardiner, Fauna Geogr. Maldives and Laccadives, ii, p. 779.

Corallum. Growth-form irregular, usually raised into hillocks. Peritheca dense, vesicles more or less filled up with spines, more abundant than in *C. chalcidicum* and arranged in rows around corallites leading up to the exsert ends of septa, each spine with side spinules, hence appearing star-shaped from above. Corallites usually close to one another, not projecting, or at most up to ·75 mm. Calices about 1·25 mm. in diameter, interior obscured owing to considerable thickness of septa.

Septa slightly exsert, arched above peritheca, sides with short spines rougher and somewhat more pointed than in *C. serailia*, marginal teeth slender and spinous. As a rule, two of the secondary septa exocoelic and appearing to belong to the third order (as there are usually only four secondary mesenterial couples in the polyps), and only eight tertiary exocœlic septa; of these ten septa meeting the columella equally thick, the remaining ten very narrow and alternating with them. Costæ sunk in peritheca, represented by the rows of spines leading up to the exsert septa. Columella thicker than in the last two species with higher rods projecting into calyx. Corallum rougher than in any other species.

Polyps. (1) Secondary entocœlic tentacles present. (2) In some tentacles one or two sub-terminal batteries. (3) Entocœlic pleats not so well developed as in *C. chalcidicum*, nor covering more than the outer half of primary mesenteries; non-pleatal region of mesoglæa thicker than in same species and only slightly thinner than pleatal region. (4) Endoderm thickening from skeletal attachments of primary mesenteries to stomodæal attachments of same. (5) Endoderm over stomodæum thick. (6) Filaments absent from secondary mesenteries.

Remarks. A. *Polyps.* A varying number of primary mesenteries do not reach the stomodæum, but at least one in every couple joins it. Three to six secondary couples are present, usually four.

Polyps examined, eleven, five from one specimen, three from a second specimen, three from a third specimen (all Red Sea).

B. *Corallum.* Milne Edwards and Haime have referred three specimens to *Cyphastræa microphthalma*, with which my examples agree completely, the largest from Australia measuring $18 \times 12{\cdot}5 \times 11$ cm.; of the remaining two, somewhat rubbed down specimens from Oceania, one ($5 \times 4{\cdot}5 \times 2{\cdot}5$ cm.) is in Lamarck's collection, evidently his type of *Astrea microphthalma* (Pl. **12**, fig. 9). Resembling these are Milne Edwards and Haime's three original examples of *Cyphastræa savignyi* from the Red Sea, two of which are large ($20 \times 18 \times 16$ cm. and $18 \times 10 \times 13{\cdot}5$ cm.), the third very small and broken. All these specimens are characterised by ten septa meeting the columella in each corallite and an equal number of very narrow alternating septa, dense peritheca, and prominent perithecal spines arranged in rows leading up to the exsert ends of the septa (Pl. **13**, fig. 1). At present there are no specimens in the Paris museum named *Cyphastrea muelleri*, Ed. and H., or *Solenastræa forskælana*, Ed. and H., but from Milne Edwards and Haime's descriptions of these two species they do not appear to be in any way different from *C. microphthalma*. A large specimen from Koseir named *Solenastrea chalcidicum* by Klunzinger belongs to *C. microphthalma*.

Resembling Milne Edwards and Haime's types above referred to are six specimens in the Berlin Museum, which Ehrenberg had originally referred to *Explanaria galaxia*, but which Klunzinger later brought under *Cyphastræa savignyi*, one of which he has figured. Klunzinger's example (13×7 cm.) of *Cyphastrea serailia* is identical with the edge region of specimen no. 12 on p. 47, both having projecting corallites.

Quelch's new species *Cyphastrea aspera* is based upon a very small specimen ($4 \times 3{\cdot}5$ cm.) from Api, New Hebrides; its calices are somewhat deeper, but in all other

respects it resembles *C. microphthalma*. Three specimens of the "Pola" expedition which Marenzeller has referred to *Cyphastrea savignyi*, Ed. and H., are good examples of the present species.

One of Forskål's originals of *Madrepora serailia*, measuring 18 × 12·5 × 8 cm. (Pl. **13**, fig. 2) is identical with my Red Sea examples of *C. microphthalma*. Agreeing with these completely is Esper's Pl. 34, fig. 3 of *Madrepora interstincta*. According to Milne Edwards and Haime, *Madrepora interstincta*, Linnæus, is a fossil millepore, *Heliolites interstincta*.

Localities. Red Sea (19). Chagos: Salomon (7); Egmont (2). Amirante 20—25 fms. (1). Saya de Malha 29 fms. (1). Coetivy (1). Maldives: Addu 40 fms. (1); Turadu (1); Suvadiva 31 fms. (1). Also from Australia (Milne Edwards and Haime), ? New Hebrides (Quelch), loc. ? (Esper).

4. *Cyphastrea suvadivæ*, Gardiner (Pl. **7**, fig. 7; **13**, fig. 3; **34**, fig. 6).

1889. *Cyphastræa muelleri*, Ortmann, Steinkorall. Sud. Ceylons, Zool. Jahrb., iv, p. 530.
1904. *Cyphastræa suvadivæ*, Gardiner, Fauna Geogr., Maldives and Laccadives, ii, p. 780.
1904. *Cyphastræa maldivensis*, Gardiner, Fauna Geogr. Maldives and Laccadives, ii, p. 780.

Corallum. Incrusting, thin, comparatively light. Peritheca vesicular, vesicles on surface like blisters, often with walls incomplete, but where complete granular, dissepiments very thin and wider apart than in all previous species. Corallites from 2—4 mm. apart, not projecting. Calices about 1·5 mm. in diameter, shallower than in other species.

Septa slightly or not at all exsert, very thin, sides smooth or slightly rough; primaries as thin as secondaries, both orders meeting columella and having long, pointed, spinous teeth extending over the axial fossa. Costæ sunk in peritheca. Columella more openly trabecular than in *C. chalcidicum*, hardly any rods projecting into calyx.

Professor Gardiner's type specimens of *C. suvadivæ* were all very small broken pieces; the shallow, closed-in nature of the corallites may be due to the pieces having been broken off the edge of a large specimen.

Polyps. (1) Secondary entocœlic tentacles present. (2) A single, sub-terminal battery on each primary entocœlic tentacle—none on others. (3) Entocœlic pleats only in the second quarter of width of primary mesenteries from skeletal attachment, well constricted at their bases, comparatively few in number (from 8—11, in last two species over 20), thinner and further apart than in any previous species; mesenterial mesoglæa also thinner. (4) Endoderm a thin layer in the first quarter of width of primary mesenteries, thickening towards stomodæal attachment, but less than in *C. microphthalma*. (5) Endoderm over stomodæum thick. (6) Filaments absent from secondary mesenteries.

Remarks. A. *Polyps.* Nematocysts I are closely packed in the terminal batteries, while type II *b* are nearly absent. Nematocysts II are of common occurrence in the convolutions of the mesenterial filaments, while III are less frequently found. In the first quarter of primary mesenteries the mesoglæa is extremely thin. The endoderm is less vacuolated than in *C. microphthalma*; in the edge-zone, oral-disc and upper half of

LIST OF SPECIMENS SHOWING THE EXTENT OF VARIATION IN THE GENUS *CYPHASTREA*.

No. of Specimen	Locality	Species	Remarks
1	Amirante	*C. serailia*	Corallum (15 × 15 cm.) incrusting on a rounded mass which is covered with corallites except at its place of attachment. Primaries often resemble secondaries as in *C. chalcidicum*. Peritheca completely vesicular as in *C. suvadivæ* and corallites 2·5 or 3 mm. apart. Pl. 11, fig. 1; Pl. 13, fig. 8.
2	Red Sea	,,	Corallum (15 × 12 cm.) incrusting on a hillocky mass. Some of the corallites simulate those of *C. chalcidicum*—primaries as thin as secondaries, both with almost smooth sides, columella openly trabecular. Towards edge corallites sunk and shallow. A giant corallite 2·5 mm. in diameter with $\widetilde{9, 9}$, and 18 septa.
3	Amirante	,,	A small incrusting mass (8 × 6 cm.). Septal teeth somewhat long and slender at bases of calices, approaching condition in *C. suvadivæ*.
4	Hulule, Maldives	,,	Corallum incrusting (11 × 8 cm.). Most corallites with secondaries not meeting columella, resembling Ed. and H.'s fig. of *S. sarcinula*. Towards edge corallites shallow. Pl. 11, fig. 2.
5	Red Sea	*C. chalcidicum*	Corallum (18 × 13 × 10 cm.) massive with hillocks. Corallites on some hillocks agree completely with Klunzinger's type of *C. chalcidicum*—projecting cylinders, 1 mm. or more deep and 2 mm. in diameter. In valleys corallites level with surface and narrow (1·25 mm. wide). Pl. 12, fig. 1.
6	Singapore	,,	Corallum (10 × 9 × 7 cm.) incrusting on an irregular surface; corallites not projecting on flat areas, on humps up to 1·5 mm.—completely resembles Studer's fig. of *C. ocellina*. Two giant corallites each with 20 septa meeting columella. Pl. 12, fig. 2.
7	Red Sea	,,	Corallum (19 × 16 × 12 cm.) incrusting but raised into branching hillocks, some parts simulating Gardiner's examples of *C. maldivensis*—vesicular peritheca, corallites 2·5 mm. apart, costæ sunk in peritheca, septal teeth long, slender, tending to be fenestrated over axial fossa. In valleys calices only 1 mm. in diameter. A giant corallite 2·5 mm. wide with $\widetilde{9, 9}$, and 18 septa, another in fission with diameters 3 mm. and 2 mm. and 21 septa meeting columella.
8	Turadu, Maldives	*C. microphthalma*	Typical (10 × 8 cm.). Towards edge resembles Klunzinger's fig. of *C. savignyi*.
9	Egmont, Chagos	,,	Corallum (14 × 9 × 8 cm.) incrusting with humps. Septa 10 and 10. As in *C. serailia* primaries much thicker than secondaries, exsert, and sides of both rough—specimen resembles Klunzinger's fig. of *C. savignyi*. Pl. 12, fig. 6.
10	Salomon, Chagos	,,	Corallum small (9 × 7 × 5 cm.). Intermediate stages in corallites between *C. serailia* and *C. microphthalma*—septa $\widetilde{6, 5}$ and $\widetilde{6, 4}$ and 10, and 10 and 10. Perithecal spines low, blunt, scattered.

LIST OF SPECIMENS SHOWING THE EXTENT OF VARIATION IN THE GENUS *CYPHASTREA—continued.*

No. of Specimen	Locality	Species	Remarks
11	Red Sea	*C. microphthalma*	Corallum (11 × 9 × 4 cm.) incrusting. Septa thin and only slightly rough as in *C. chalcidicum* but no. 10, and 10. Perithecal spines almost smooth. Pl. 12, fig. 7.
12	,,	,,	Corallum (14 × 8 × 9 cm.) raised into humps, identical with Klunzinger's figured specimen of *C. serailia*. Pl. 12, fig. 5.
13	Salomon, Chagos	,,	Corallum (17 × 12 × 12 cm.) incrusting, resembles Klunzinger's fig. of *C. savignyi*. Corallites shallow, 2·5—3 mm. apart, sunk, only granules on peritheca.
14	Red Sea	,,	Corallum (15 × 8 × 17 cm.) large, raised into hillocks—resembles Klunzinger's fig. of *C. serailia*—towards edge similar to fig. of *C. savignyi*. Pl. 34, fig. 4.
15	,,	,,	Corallum (25 × 18 × 19 cm.) raised into humps on a large substratum. In a flat valley corallites crowded, thin-walled and columella rudimentary. Three giant corallites each 2·5 mm. wide with 18 septa meeting columella. Pl. 12, fig. 4.
16	,,	,,	Corallum (20 × 12 × 13 cm.) with hillocks and deep valleys. Towards edge corallites shallow and closed in. Two giant corallites, 2 5 mm. wide with 16 and 18 septa meeting columella. Pl. 13, fig. 7.
17	Salomon, Chagos	,,	Corallum small (12 × 9 × 5 cm.). Similar to *C. chalcidicum* except in number of septa and dense columella—peritheca in parts vesicular where spines few, short, blunt, smooth, scattered, septa thin, only slightly rough.
18	Red Sea	,,	Corallum small (10 × 7 × 7 cm.)—great variation in number of septa, a few corallites with 12 and 12, many with 10 and 10 or 9 and 9, some others with 8 and 8.
19	Suvadiva, Maldives	*C. suvadivæ*	Prof. Gardiner's specimens of *C. suvadivæ*—small broken pieces; all flat, thin corallites shallow with a closed in appearance, low thin perithecal spines, sometimes only 11 septa meeting columella.
20	Hulule, Maldives	*C. hemprichana*	Corallum large (11 × 8 × 5·5 cm.) with even surface. Condition typical on upper surface—on lower surface hardly any perithecal spines, corallites not projecting, shallower, hence columella visible. Pl. 13, fig. 5; Pl. 34, fig. 5.
21	Red Sea	,,	Corallum small (6 × 6 × 4 cm.) with low humps. Calices somewhat shallow, hence columella visible with conspicuous rods. Septa usually 6, 4 and 10, only primaries meeting columella.
22	Rotuma	,,	Prof. Gardiner's specimen of *C. chalcidicum* (16 × 10 × 7·5 cm.)—rougher (perithecal spines and septa) than specimens 20 and 21, also corallite-wall thicker and calices somewhat wider (1·75 mm.), columella distinctly seen, well developed, with conspicuous rods, septa 6, 6 and 12 primaries not much thicker or broader than secondaries, the latter in some corallites meeting columella. Pl. 13, fig. 4.

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body-wall it is extremely thin, while in the secondary mesenteries it is a uniformly thin layer on either side of the mesoglæa.

Polyps examined, seven, three from a well-preserved specimen from Suvadiva, four from a badly-preserved specimen from Saya de Malha.

B. *Corallum.* A specimen from Ceylon in the Berlin Museum, measuring 8 × 8 cm., which Ortmann had referred to *Cyphastræa muelleri*, resembles the present species in the highly vesicular condition of its peritheca and in the thinness of its septa, but the septal teeth are not quite so long as in *Cyphastræa maldivensis*, Gard., and the corallites are slightly projecting.

Localities. Maldives: Felidu 20—25 fms. (1); S. Nilandu 25 fms. (1); Suvadiva (small fragments). Saya de Malha 26—29 fms. (3). Amirante 725 fms. (1). Cargados 30 fms. (1). Also from Ceylon (Ortmann).

5. *Cyphastrea gardineri*, n. sp. (Pl. **13**, figs. 4 and 5; **34**, fig. 5.)

1899. *Cyphastræa chalcidicum*, Gardiner, Proc. Zool. Soc. London, p. 761 (non *Cyphastræa chalcidicum*, Klunzinger).

1904. *Cyphastræa hemprichana*, Gardiner, Fauna Geogr. Maldives and Laccadives, ii, p. 779 (non *Solenastræa hemprichana*, Milne Edwards and Haime).

Corallum. With either even surface or raised into low humps. Peritheca dense, dissepiments much thickened as in *C. microphthalma*, with conspicuous, blunt, somewhat smooth spines, thicker and higher than in any other previous species, and irregularly distributed. Corallites from almost touching to 2 mm. apart, projecting up to ·75 mm. Calices about 1·5 mm. in diameter, deep.

Septa exsert, sides rough, inner margins perpendicular with short blunt teeth, decreasing in width and thickness from primaries to tertiaries; only primaries meeting columella, but narrower than in other species. Costæ distinct on projecting corallite-walls. Columella deep down in calyx, often invisible from above.

No Polyps.

This species differs from both *Solenastræa hemprichana*, Ed. and H., and *Cyphastræa chalcidicum*, Klunz., in the following respects: (1) dense peritheca, (2) perithecal spines numerous and prominent (in these characters approaching *C. microphthalma*, but the spines are usually blunt and somewhat smooth), (3) calices somewhat deeper, hence columella often invisible from above, (4) septa thicker and rougher (in this respect resembling *C. serailia*). In the cylinder-like appearance of the corallites the species agrees with *C. chalcidicum*. Its true position in the genus can, however, be determined only after an examination of its polyps.

Localities. Red Sea (1). Rotuma (1). Maldives, Hulule (1).

Echinopora, Lamarck.

1816. *Echinopora*, Lamarck, His. anim. sans. vert., ii, p. 252.

1816. *Explanaria* (pars), Lamarck, His. anim. sans. vert., ii, p. 254.

1830. *Echinastrea*, Blainville, Dict. Sci. Nat., lx, p. 327.

1830. *Tridacophyllia* (pars), Blainville, Dict. Sci. Nat., lx, p. 343.

1834. *Stephanocora*, Ehrenberg, Corall. roth. Meer., p. 76.

1834. *Explanaria* (pars), Ehrenberg, Corall. roth. Meer., p. 82.

1848. *Echinopora* (pars), Dana, Expl. exp. Zooph., p. 277.
1850. *Astrea* (pars), Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 97.
1850. *Echinopora* (pars), Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 621.
1857. *Heliastræa* (pars), Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 456.
1857. *Echinopora* (pars), Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 621.
1879. *Orbicella* (pars), Klunzinger, Korall. Roth. Meer., iii, p. 47.
1879. *Echinopora*, Klunzinger, Korall. Roth. Meer., iii, p. 54.
1884. *Echinopora*, Duncan, Journ. Linn. Soc. London, Zool., xviii, p. 117.
1889. *Echinopora*, Ortmann, Steinkorall. Süd. Ceylons, Zool. Jahrb., iv, p. 530.
1904. *Echinopora* (pars), Gardiner, Fauna Geogr. Maldives and Laccadives, p. 782.

Corallum. Varying considerably, flat, thin and foliaceous to massive, and rising into branching hillocks. Peritheca vesicular or dense, the vesicles being often filled up, usually with upright spinulate echinulations arranged in rows connecting costæ of neighbouring corallites, their bases often fused to form ridges which are specially distinct towards edges where spines are small or absent. Corallites round or oval, close or quite separated, level or projecting up to a height of 6 mm., usually one side more than the other, near the edges of corallum the sides facing same not projecting at all. Calices not deep, sometimes almost flat. Septa from 3—5 orders, side spinulose, exsert up to 2 mm., on edges confluent with perithecal costæ. Paliform lobes present or absent. Costæ always present, varying in thickness, usually with upright spines. Often the last order of septa distinguishable only in costæ. Columella spongy, formed of trabeculæ from septal margins.

Polyps. Circular or oval; when corallites project, edge-zones cover their entire free surface; cœnosarcal regions usually extensive, varying in width up to 6 mm. Mesenteries in three cycles, 6, 6 and 12 couples, last sometimes incomplete, primaries meeting stomodæum, all with filaments. Tentacles entocœlic and exocœlic, but number always equalling that of the entocœles and exocœles, each with a large knobbed terminal battery and from three to six smaller sub-terminal ones. Stomodæum usually laterally compressed, with two directive grooves. Nematocysts III uniformly modified into the III *b* type in all polyps examined; nematocysts II with the dark-stained axis extending to even more than two-thirds length of sac. Tentacular endoderm much thickened owing to vacuolation and somewhat lobulated, the protoplasm being reduced to thin strands, appearing transparent owing to scarcity of algæ.

Multiplication by budding, usually from cœnosarc, sometimes from edge-zone.

Verrill rightly separated *E. aspera*, Ed. and H., from *Echinopora*, and established a new genus, *Trachypora*, for it. Klunzinger later substituted *Echinophyllia* for this genus. In Lamarck's collection in the Paris Museum there are two specimens from the Indian Ocean named *E. aspera* by Milne Edwards and Haime, which obviously were Lamarck's originals of *Explanaria aspera*; these resemble *Mycedium okeni*, Ed. and H. (Fungidæ), of which there are two large examples in the Paris Museum. I have not been able to see Klunzinger's example of *Echinophyllia aspera*, but from his figure it appears to be a near relative of *E. aspera*, Ed. and H., though not quite identical with it.

Gardiner's small figured type of *E. magna* has a thicker facies than *E. aspera*, Ed. and H., resembling Milne Edwards and Haime's larger example of *Mycedium okeni*.

Distribution. Red Sea, Indian and Pacific Oceans.

1. *Echinopora lamellosa* (Esper). (Pl. **8**, fig. 6; **14**, figs. 2—6; **15**, fig. 1; **16**, fig. 6.)

1797. *Madrepora lamellosa*, Esper, Forts. Pflanz., p. 65, pl. 58, figs. 1 and 2.
1816. *Echinopora rosularia*, Lamarck, Hist. Anim. sans vert., ii, p. 253—2e édit., p. 397.
1830. *Echinastrea rosularia*, Blainville, Dict. Sci. Nat. lx, p. 344, pl. 35, fig. 2—Manuel d'Actinol., p. 378, pl. 56, fig. 2.
1848. *Echinopora undulata*, Dana, Expl. exp. Zooph., p. 278, pl. 17, fig. 3.
1848. *Echinopora rosularia*, Dana, Expl. exp. Zooph., p. 279.
1848. *Echinopora reflexa*, Dana, Expl. exp. Zooph., p. 280, pl. 17, fig. 2.
?1848. *Echinopora horrida*, Dana, Expl. exp. Zooph., p. 282, pl. 17, fig. 4.
18 . *Echinopora rosularia*, Milne Edwards, Atlas grande édit. Régne anim. Cuvier, Zooph., pl. 85 ter.
1850. *Echinopora rosularia* (pars), Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 185.
1857. *Echinopora rosularia* (pars), Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 623.
1864. *Echinopora flexuosa*, Verrill, Bull. Mus. Comp. Zool. Harvard, i, p. 54.
1877. *Echinopora rosularia*, Studer, Monat. Ak. Wiss. Berlin, p. 643.
1877. *Echinopora flexuosa*, Studer, Monat. Ak. Wiss. Berlin, p. 643.
1877. *Echinopora striatula*, Studer, Monat. Ak. Wiss. Berlin, p. 644, fig. 10*a* and *b*.
1889. *Echinopora rosularia*, Ortmann, Steinkorall. Süd. Ceylons, Zool. Jahrb., iv, p. 531.
1904. *Echinopora rosularia*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 782, pl. 63, fig. 37.

Corallum. Very thin, margins irregularly folded up, attached below in the centre. Peritheca dense, with slender spinulate echinulations, their bases usually fused to form low thin perithecal costæ, towards edges of corallum spines disappearing but ridges remaining. Corallites almost circular, projecting up to 2 mm. (usually 1·25 mm.), up to 6 mm. apart (average 3 mm.). Calices with diameter 3·5 mm., depth 1·5 mm.; quite shallow towards edges of corallum.

Septa in three orders, tertiaries very thin, up to 4 quaternaries sometimes present, sides rough, perforated, edges denticulate. Primaries sometimes thicker than secondaries, these and up to 6 tertiaries meeting columella; septa of even thickness along their breadth or somewhat thickened in thecæ, margins vertical, exsert to 1 mm. The exsert ends of primaries and secondaries divided by two notches—not extending below calicular margins—into an inner arched lobe and two outer bluntly-pointed teeth, the last appearing as the first costal tooth. Costæ comparatively thin, with one or two spinulate echinulations. Columella of close trabeculæ, up to two-thirds width of calyx.

Polyps. (1) Tertiary couples of mesenteries absent. (2) Directive grooves deep and narrow. (3) Nematocysts I less numerous in ectoderm of oral-disc and outer wall of edge-zone than in *E. gemmacea*, but fewer in stomodæal ridges and in straight regions of mesenterial filaments than in *E. hirsutissima*. (4) Entocœlic pleats in stomodæal region of polyp horizontal, better developed than in *E. hirsutissima* or *E. gemmacea*, being thick, unconstricted at their bases, extending over the outer half of primary mesenteries and more or less of uniform size along the entire pleatal region; mesoglæa thickest in pleatal region; no exocœlic pleats. (5) Mesenterial endoderm of more or less uniform thickness along the entire width of primary mesenteries. (6) Endoderm in outer wall of edge-zone as thick as the ectoderm over it, somewhat thinner in oral-disc. (7) Convolutions of mesenteries abundant towards bases of polyps.

Remarks. A. *Polyps.* The polyps are circular in outline, relatively small, the largest one being 4 mm. in height and 2·5 mm. in diameter and invariably directed obliquely

downwards. The convolutions of mesenteries are scarce to some distance below the stomodæum, becoming more abundant towards bases of polyps. Tentacles corresponding in number and position with entocœles and exocœles. The stomodæum is much compressed laterally, with diameters 1 mm. and ·4 mm.; its ridges are somewhat thicker than in the next species, those of adjacent mesenteries of neighbouring primary couples sometimes fusing in the upper part of the stomodæum as in *Goniastrea retiformis*. Nematocysts I are rare in the ridges and in the straight regions of mesenterial filaments.

The endoderm is extremely thin in the region of the terminal batteries, non-vacuolated and with a row of algæ, below this vacuolated and transparent with very few algæ as in *E. hirsutissima* but not quite so thick as the sub-terminal batteries; stomodæal endoderm is thicker than in the same species owing to greater vacuolation; mesenterial endoderm behind filament not so thickened.

Gonads were not present in any of the polyps sectioned. Polyps examined, four—two from one specimen and two from a second, both from Hulule, Maldives.

B. *Corallum.* Of the six specimens in the Paris Museum referred by Milne Edwards and Haime to *E. rosularia*, five belong to the present species; of these, two large ones from Seychelles (the larger measuring 26 × 19 cm.) have the same facies as many of my examples from Seychelles, being thin and folded with poorly developed columellæ; another specimen from the same locality is denser, up to 1·5 cm. thick, with most of the corallites level, perithecal spines thicker and columella better developed, about $\frac{1}{3}$ width of calyx; the remaining two specimens are smaller, a rubbed one from Red Sea (15 × 8 cm.) and another (9 × 7 cm.) from Australia. A specimen (13·5 × 12 cm.) from Singapore named *E. flexuosa*, Verrill, has corallites on both sides of the corallum. Four cylindrical examples from Fiji (the longest 9 cm.), named *E. horrida*, Dana, have a tree-like mode of growth with few perithecal spines; these are not a dendroid variety of *E. hirsutissima* as Milne Edwards and Haime had supposed, but belong to the present species.

Of the "Gazelle" specimens in the Berlin Museum, Studer has referred three large ones from Salawatti to *E. rosularia*, another large one from the same locality to *E. flexuosa*, Verrill, in every respect resembling the like named specimen in the Paris Museum, and a number of good examples to his new species *E. striatula* which more or less resemble specimen no. 3 on p. 57; these differ from my typical condition of *E. lamellosa* in that the perithecal spines are shorter, many of them level, corallites on both sides of the corallum (in this respect agreeing with *E. flexuosa*) and almost flat, columella not more than one-third width of calyx. A specimen from Ceylon is referred by Ortmann to *E. rosularia*.

There is hardly any doubt that Esper's type of *E. lamellosa*, judging from the two figures he has given, is identical with mine.

Localities. Maldives, Hulule (6). Chagos: Salomon (9); Coin, Peros (2). Seychelles (4). Also from Australia (Milne Edwards and Haime), ?Singapore (Verrill), Fiji Islands, New Holland and East Indies (Dana), Salawatti and New Britain (Studer), Ceylon (Ortmann), ?loc. (Esper).

2. *Echinopora hirsutissima*, Milne Edwards and Haime. (Pl. **8**, fig. 5; **9**, fig. 4; **13**, figs 7 and 8; **15**, figs 2—4; **17**, fig. 1; **34**, fig. 7.)

1816. *Explanaria gemmacea*, var. *stellis comosis*, Lamarck, Hist. Anim. sans vert., ii, p. 256; 2e édit., p. 399.
? 1848. *Echinopora ringens*, Dana, Expl. exp. Zooph., p. 279.
1850. *Echinopora rosularia* (pars), Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 185.
1850. *Echinopora hirsutissima*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 187.
1854. *Echinopora helli*, Louis Rousseau, Voy. pôle sud Dumont-d'Urville, Zool., v, p. 120, Zooph., pl. 27, fig. 3.
1857. *Echinopora helli*, Milne Edwards and Haime, Hist. nat. Corall., ii, p. 623.
1857. *Echinopora rosularia* (pars), Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 623.
1857. *Echinopora hirsutissima*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 624.
1904. *Echinopora solidior*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 782, pl. 63, fig. 38 (non *Echinopora solidior*, Milne Edwards and Haime).
1904. *Echinopora tertia*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 782, pl. 63, fig. 39.

Corallum. Incrusting, relatively thin, much coarser than in *E. lamellosa*, edges usually somewhat folded over, free only at edges. Peritheca dense, with upright blunt spinulate echinulations up to 1 mm. in height, bases of spines sometimes united to form ridges especially seen towards edges. Corallites oval, sometimes circular, level with general surface to 1 mm. high, touching or up to 4 mm. apart, usually 2 or 3 mm. Calices up to 8 mm. in diameter, average 5·5—6·5 × 4·5—5 mm., depth 2 mm.

Septa in four orders, the fourth incomplete, comparatively broader than in *E. lamellosa*, sides spinulate, edges denticulate. Primaries thicker than secondaries; both these and a varying number of tertiaries—up to 8—with their outer half or a little more thicker, from 5—7·5 mm., dipping down vertically till level of columella, then thinning out and extending horizontally inwards to meet the latter, around which is a ring of about 12 spinulate pali each 1·5 mm. high. Septa meeting columella exsert to 1·5 mm., exsert end divided over the calicular margin by a deep notch into an inner lobe about 1 mm. broad and an outer narrower lobe, the latter sometimes appearing as the first costal tooth. Septa often perforated behind pali, hence the latter appearing connected by slender rods to the septal margins. The tertiaries not meeting columella curve towards and fuse with sides of secondaries near to columella. Quaternaries very narrow and thin, up to 14 in number. Costæ of primaries to tertiaries with 1—3 conspicuous blunt upright spinulate echinulations, those of quaternaries thin and inconspicuous. Columella about one-third width of calyx or slightly more.

The corallum of this species is very variable. *E. tertia*, Gard. (Pl. **15,** fig. 3 and **17,** fig. 1) with identical polyp-structure as *E. hirsutissima* is only a skeletal variety, differing from it in the following respects:—(1) corallites projecting up to 2 mm., somewhat further apart; (2) costal and perithecal spines thinner and shorter, in places not regularly arranged; (3) septa less exsert, thinner and more perforated, the gaps often seen in the edges leaving slender irregular processes which tend to intercross over the axial fossæ; (4) columella somewhat less than one-third width of calyx and formed of looser trabeculæ. Another specimen with similar polyp-structure resembles *E. lamellosa* (Pl. **14,** fig. 7) in skeletal characters more than *E. hirsutissima*—slender shorter perithecal spines, corallites more exsert (to 2 mm.), calices circular and smaller, septa thinner, columella half width of calyx—but has a greater number of quaternaries, up to 14 as in *E. hirsutissima*, and a ring of about 12 pali not rising above calicular margin.

Polyps. (1) Tertiary couples of mesenteries sometimes complete with 12 couples, often incomplete (occasionally a quaternary couple present). (2) Directive grooves not deep. (3) Nematocysts I less numerous in ectoderm of oral-disc and outer wall of edge-zone than in *E. gemmacea*, but more numerous in lower halves of stomodæal ridges and in straight regions of mesenterial filaments than in that species. (4) Entocœlic pleats in stomodæal region of polyp horizontal, extremely narrow, thin, comparatively few and not extending to beyond the outer halves of primary mesenteries, usually restricted to their outer one-third; inner one-fifth of mesenterial mesoglæa much thickened, bearing exocœlic pleats sometimes better developed than entocœlic ones. (5) Mesenterial endoderm thicker on either side of inner stouter region of mesoglæa. (6) Endoderm in outer wall of edge-zone as thick as the ectoderm over it, somewhat thinner in oral-disc. (7) Convolutions of mesenteries scarce towards bases of polyps.

Remarks. A. *Polyps.* These are oval in outline, height about 6 mm., in retraction, with diameters 5 mm. and 3·5 mm., smaller towards edges of colonies. The primary mesenteries are usually attached to the sides of the septa a short distance from the theca, while the remaining mesenteries are attached at the angles between walls and septa. The convolutions of the mesenteries are scarce in the stomodæal region of the polyp, but are protruded into the edge-zone and through the oral-disc; they are abundant below the stomodæum, becoming scarce again towards the base of the polyp. From every entocœle arises a tentacle, but it has not been possible to count the exact numbers of exocœlic tentacles; the terminal batteries contain closely arranged nematocysts I, having from forty to forty-five turns of the spiral, with a few II*b* interspersed among them. The stomodæum is oval in outline with diameters 1·75 mm. and 1 mm.; one of the directive grooves is often shallow; the ridges are thicker than broad, somewhat conical in transverse section, their sides sloping away, with the mesoglæa not specially thickened at their bases; nematocysts III occasionally present, in their lower halves nematocysts I frequently found with fewer turns of the spiral. On the whole the stomodæum resembles in section that of *Favia hululensis*, Gardiner.

In the ectoderm of oral-disc and outer wall of edge-zone mucous vacuoles are commonly present, nematocysts I fairly frequent, II rare. Large vacuoles are present in the sub-terminal batteries as in *Favia doreyensis* Ed. and H. In the straight regions of mesenterial filaments nematocysts I are present in small numbers, occasionally those of II and III*b*; in their coils large numbers of nematocysts III*b* are closely arranged forming batteries, II being less numerous. In the endoderm of the outer wall of the edge-zone the nuclei are arranged along its periphery, above which algæ are massed together. In the oral-disc the endoderm is somewhat thinner and algæ are less abundant; the circular layer of muscle-fibres is evident. The endoderm in the upper part of the column-wall is extremely thin, in certain parts being as thin as the calicoblast with algæ comparatively scarce, towards the base less vacuolated, and hence less thickened than in most other genera. In the tentacles it is much vacuolated being as thick as or thicker than the sub-terminal batteries, with few algæ as in *E. lamellosa*, sometimes blocking their lumina. The mesenteral endoderm thickened behind the filaments as much as the latter, appearing pad-like in section; beyond this it is thin along the short non-pleatal

region. Algæ not abundant in the mesenteries. Below the stomodæum the entocœlic pleats extend over the greater part of the width of the mesenteries, broadening out in the median regions, some of them secondarily cleft; the mesoglæa is not thickened behind the filaments.

Polyps examined, eight, 4 from two typical specimens, 2 from specimen of *tertia* facies, 2 from specimen whose corallum has varied towards *E. lamellosa*, all from Hulule, Maldives.

B. *Corallum.* Milne Edwards and Haime's type of *E. hirsutissima* (Pl. **15,** fig. 4) from the Indian Ocean, which is very likely Lamarck's original of *Explanaria gemmacea*, var. *stellis comosis*, is a large incrusting example measuring 30 × 20 cm. with a hillock 14 cm. high, and has more or less the *tertia* facies, but its costæ and costal spines are well developed. Resembling this is a specimen (14 × 11 cm.) in the Paris Museum named *E. ringens*, Dana, but without locality. Louis Rousseau's type of *E. helli* from Seychelles—later re-described by Milne Edwards and Haime—is also a large specimen (25 × 19 × 11 cm.) somewhat flat and raised into short hillocks, on the whole resembling specimen no. 9 on p. 57, but in places the perithecal spines are strongly developed as in no. 8. One of the specimens from Bourbon, measuring 13·5 × 6·5 cm., referred by Milne Edwards and Haime to *E. rosularia*, really belongs to the present species, its corallites projecting obliquely up to 3·5 mm. with about forty septa in each, of which about twenty meet the columella ; it has more or less the *tertia* facies.

Localities. Maldives, Hulule (3). Chagos: Salomon (4); Coin, Peros (1). Also from Seychelles (Rousseau), Bourbon Island (Milne Edwards and Haime).

3. *Echinopora gemmacea* (Lamarck). (Pl. **14**, fig. 9; **15**, figs. 5 and 6; **16**, figs. 5, 7, and 8; **17**, figs. 2 and 3; **37**, fig. 5.)

1816. *Explanaria gemmacea*, Lamarck, Hist. Anim. sans vert., ii, p. 256; 2e édit., p. 399.
1830. *Echinastrea gemmacea*, Blainville, Dict. Sci. Nat., lx, p. 388 ; Manuel d'Actinol., p. 378.
1834. *Stephanocora hemprichi*, forma *fruticulosa* and forma *explanata*, Ehrenberg, Corall. roth. Meer., p. 76.
1834. *Explanaria hemprichii*, Ehrenberg, Corall. roth. Meer., p. 82.
1850. *Astrea forskaliana*, Milne-Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 100.
1850. *Echinopora gemmacea*, Milne-Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 186.
1850. *Echinopora ehrenbergi*, Milne-Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 187.
1850. *Echinopora rousseaui*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 188.
1850. *Echinopora solidior*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 189 (non *Echinopora solidior*, Gardiner).
1857. *Heliastræa forskelana*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 457, pl. D 5, fig. 3.
1857. *Echinopora gemmacea*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 622, pl. D 9, fig. 2.
1857. *Echinopora hemprichi*, Milne Edwards and Haine, Hist. Nat. Corall., ii, p. 623.
1857. *Echinopora ehrenbergi*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 625.
1857. *Echinopora solidior*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 626.
1879. *Orbicella forskâlana*, Klunzinger, Korall. Roth. Meer., iii, p. 48.
1879. *Orbicella mammillosa*, Klunzinger, Korall. Roth. Meer., iii, p. 49, pl. 5, fig. 5, pl. 10,.fig. 10 *a—c*.
1879. *Echinopora fruticculosa*, Klunzinger, Korall. Roth. Meer., iii, p. 55, pl. 6, fig. 4.
1879. *Echinopora ehrenbergi*, Klunzinger, Korall. Roth. Meer., iii, p. 56, pl. 6, figs. 7 and 9, pl. 10, fig. 15.
1879. *Echinopora concamerata*, Klunzinger, Korall. Roth. Meer., iii, p. 57, pl. 6, fig. 6.
1879. *Echinopora carduus*, Klunzinger, Korall. Roth. Meer., iii, p. 57, pl. 6, fig. 5, pl. 10, figs. 14 *a* and *b*.
1906. *Orbicella forskalana*, Marenzeller, Exp. "Pola," Roth. Meer., Riffkorall., Zool. Ergeb. Wien, xxvi, p. 61.

Corallum. All the variations in growth-form of the genus. Peritheca usually vesicular, walls of vesicles about ·75 mm. apart, with distinct ridges connecting neighbouring costæ; spines present or absent. Corallites usually circular, projecting in different directions, vertical, oblique, or quite horizontal, up to 6 mm., usually about 3 mm., increasing in diameter from margins to bases, up to 6 mm. apart, average 2 or 2·5 mm. Calices with diameter up to 7 mm., depth 2 mm.

Septa in four orders, up to 18 quaternaries, sides spinulate, edges denticulate. Primaries sometimes thicker than secondaries, these and up to 8 tertiaries meeting columella. Primaries and secondaries with their outer halves usually twice or thrice the thickness of the inner halves, dipping down vertically till level of columella, then thinning out and passing horizontally inwards to meet columella, exsert to 1 mm., the exsert end of each often divided by a notch over corallite-wall into a somewhat larger inner lobe and a smaller outer lobe, sometimes arched, not divided. Pali less than 12, about 6 or altogether absent. Septa perforated, the gaps in edges often leaving long, slender processes which in some corallites form fenestræ over the axial fossæ. Those tertiaries not meeting columella usually curve towards and fuse with sides of secondaries, quaternaries also with tertiaries. Costæ usually low flat ridges with spinulate, blunt, upright echinulations, varying in height and degree of roughness and presenting an appearance of large and small ridges as the costæ of the last cycle are much less conspicuous, the latter sometimes absent. Columella formed of loosely twisted trabeculæ, about one-third width of calyx.

Polyps. (1) A few tertiary couples of mesenteries present, the cycle being never complete. (2) Directive grooves not deep. (3) Nematocysts I more numerous in ectoderm of oral-disc and outer wall of edge-zone than in *E. hirsutissima*, but less abundant in lower halves of stomodæal ridges and in straight regions of mesenterial filaments than in that species. (4) Entocœlic pleats in stomodæal region of polyps obliquely directed towards stomodæum, narrower than in *E. hirsutissima*, and not extending beyond the outer halves of primary mesenteries, usually restricted to their outer one-third; pleatal region much thicker than non-pleatal region; no exocœlic pleats. (5) Mesenterial endoderm thicker near stomodæal attachments than elsewhere. (6) Endoderm in outer wall of edge-zone two-thirds the thickness of the ectoderm over it, much thinner in oral-disc. (7) Convolutions of mesenteries scarce towards bases of polyps.

Remarks. A. *Polyps.* These are circular in outline about 3·5 mm. in diameter. Tentacles are not present over the tertiary entocœles, and only a few exocœlic tentacles are present; as all the tentacles were in a retracted condition exact counting of the sub-terminal batteries was impossible. The stomodæum is 1·35 mm. long by ·75 mm. broad; one directive groove is better developed than the other; the ridges are narrower than in *E. hirsutissima*. In the three polyps examined 2, 3, and 6 couples of tertiary mesenteries are present.

The ectoderm of the oral-disc and of the outer wall of the edge-zone are somewhat thicker than in *E. hirsutissima*, with abundant mucous vacuoles. In most of the nematocysts III *b* the coiled thread is partially extruded; the dark-stained axis of II

is usually somewhat bent. In the endoderm of the oral-disc algæ are not massed together, hence its vacuolated condition better seen; the nuclei are not arranged along its periphery as in the previous two species; the circular layer of muscle-fibres is distinctly visible. The mesenterial endoderm appears somewhat diffuse and transparent, with fewer algæ than in the two previous species, and is not specially thickened into a pad behind the filaments. Gonads were not present in any of the polyps examined

Polyps examined, three; from a specimen from Dongonab, Red Sea.

B. *Corallum.* In the Paris Museum there are three specimens referred by Lamarck to *Explanaria gemmacea*, later re-described by Milne Edwards and Haime as *Echinopora gemmacea*; one (9 × 9 cm.) of these from the Red Sea is identical with my types of the present species; another (10 × 9 cm.) from the Indian Ocean is a concavo-convex specimen, with a short hump and with the corallites projecting obliquely, in every respect resembling specimen no. 12 on p. 57; the third (8 × 7·5 cm.) from the same locality is a flat, somewhat worn-out example. Seven excellent specimens have been assigned by Milne Edwards and Haime to *E. ehrenbergi*; two of these from Seychelles (30 × 21 cm. and 25 × 23 cm.) have typical corallites on the flat regions, but on the frequently branching hillocks corallites and peritheca are much coarser, as in specimen no. 10 on p. 57; a specimen (19·5 × 11·5 cm.) from Red Sea, with humps, has obliquely projecting corallites and a few short perithecal spines resembling no. 12; another specimen (19 × 18 cm.) from the same locality has an incrusting corallum rising into branching hillocks, the flat regions resembling no. 13, while the hillocks are identical with *Stephanocora hemprichi* forma *fruticulosa* of Ehrenberg; the remaining three specimens from Red Sea have the *fruticulosa* facies, but the calices are somewhat smaller, 4—5 mm. in diameter. Milne Edwards and Haime's original of *E. solidior* (22 × 19 cm., Pl. **16**, fig. 5) has an incrusting corallum raised into short humps, being identical with my typical specimens of *E. gemmacea*; the average diameter of its calices is about 5·5 mm.; perithecal spines are slender and septa thin in calices. There are no specimens at present in the Paris Museum named *E. hemprichi*, but doubtless the species comes under *E. gemmacea*.

I have carefully examined the five large specimens from Red Sea, for which Milne Edwards and Haime constituted a new species *Heliastræa forskælana*, and have no hesitation in referring them to *E. gemmacea*.

In the Berlin Museum are three specimens referred by Klunzinger to *E. ehrenbergi*; two of these were Ehrenberg's originals of *Stephanocora hemprichi*. Klunzinger has figured the smaller (Pl. VI, fig. 7); the larger measures 25 × 16 cm.; the remaining one is a small edge specimen, 9 × 6 cm, which also has been figured (Pl. VI, fig. 9). Ehrenberg's type of *Stephanocora hemprichi* forma *fruticulosa* is a large specimen with a dendroid mode of growth, inconspicuous perithecal and costal spines, costæ continuous from corallite to corallite over the perithecal regions, and calices somewhat larger. Klunzinger separated it into a new species *E. fruticulosa*, but it is only a skeletal variety of the present species, as is evident from some of Milne Edwards and Haime's examples of *E. ehrenbergi*, on which *fruticulosa* hillocks are seen on typical coralla (see Pl. **16**, fig. 5). Klunzinger's type (20·5 × 12·5 cm.) of *E. concamerata*—formerly Ehrenberg's example of *Explanaria hemprichi*—has some of the characters of *E. lamellosa*, Esper,

LIST OF SPECIMENS SHOWING THE EXTENT OF VARIATION IN THE GENUS *ECHINOPORA*.

No. of Specimen	Locality	Species	Remarks
1	Hulule, Maldives	*E. lamellosa*	Corallum 14 × 9 × 7 cm. A ring of about 12 paliform lobes in corallites. Columella one-third width of calyx. Perithecal spines shorter than type. Pl. 14, fig. 3.
2	Coin, Peros, Chagos	,,	Specimen large, 28 × 14 × 2 cm. Corallites projecting up to 4·6 mm. increasing in diameter from free margins (up to 3 mm.) to bases (up to 5 mm.). Primaries and secondaries similar, thinner than in type specimens. Pl. 14, fig. 4.
3	Seychelles	,, (?)	A small edge-piece (10 × 7 cm.). Corallites level with surface. About 24 thin septa, 12 meeting columella, all slightly exsert. Columella one-quarter to one-third width of calyx. Largest calyx 2·5 mm. in diameter, resembling *E. striatula*, Stud.
4	,,	,,	Specimen 13 × 11 cm. Columella indistinct. A ring of 12 paliform lobes present. Pl. 14, fig. 5.
5	Salomon, Chagos	,,	Specimen 13 × 9 cm. Corallites projecting up to 4 mm., primaries much thicker than secondaries. Columella rudimentary one-fifth to one-quarter width of calyx. Pl. 14, fig. 6.
6	Hulule, Maldives	*E. hirsutissima*	Corallum (14 × 10 × 7 cm.). with the *tertia* facies.
7	,,	,,	Specimen small, simulates *E. lamellosa*. Pl. 14, fig. 7.
8	Coin, Peros, Chagos	,,	Specimen flat (17 × 14 cm.). Calices larger than in type specimens up to 8 mm. in diameter. Septa up to 44, up to 22 meeting columella; primaries usually much thickened in their outer halves. Pl. 15, fig. 2.
9	Salomon, Chagos	,,	Corallum 13 × 8 × 4 cm. with the *tertia* facies but calices larger, up to 7·25 × 5 mm. Septa up to 44, up to 19 meeting columella—resembling Milne-Edwards and Haime's type of *E. helli*. Pl. 15, fig. 3.
10	Dongonab, Red Sea	*E. gemmacea*	Corallum incrusting on a large irregular mass (33 × 30 × 23 cm.) and rising into a great many branching hillocks. Corallites and peritheca very coarse. Corallites on hillocks projecting in all directions vertical, horizontal and oblique, in valleys level. Pl. 16, fig. 8.
11	,,	,,	Corallum 17 × 13 × 10 cm. On one side costae thin and perithecal spines slender, few and only slightly rough; on another side typical. Pl. 37, fig. 5.
12	,,	,,	Corallum (11 × 8 cm.) incrusting on a concavo-convex surface. Corallites projecting obliquely towards edges, sometimes almost horizontal, height up to 9 mm. Perithecal spines very short or absent. Pl. 15, fig. 6.
13	,,	,,	Corallum (13 × 14 cm.) broken off, with a thick stem and short dividing branches on it. Calices shallow, sometimes almost flat. Up to 20 septa making columella, pali inconspicuous. Costae thin, spines short on costae, absent on peritheca. Pl. 16, fig. 7; Pl. 17, fig. 3.
14	,,	,,	Specimen (15 × 12 cm.) resembles Klunzinger's fig. of *E. concamerata*. Pl. 17, fig. 2.

viz. thin fan-shaped corallum, small corallites each with not more than thirty septa, usually twenty-four; but it has the rougher facies of *E. gemmacea*, the resemblance to *E. lamellosa* being due to its having been an edge piece. Two specimens are referred by Klunzinger to his new species *E. carduus*, but this is only a variety of the present species, having long, rough costal spines. Klunzinger's figured type ($14 \times 9{\cdot}5 \times 7$ cm.) of *Orbicella mammillosa* is in no way different from Milne Edwards and Haime's examples of *Heliastræa forskælana*, and like them undoubtedly belongs to *E. gemmacea*. A large specimen from Dar-es-salaam named *E. hemprichi*, Ed. and H., by Ortmann also belongs to the present species.

Of the "Pola" specimens in the Hofmuseum, Vienna, which come under the present species, Marenzeller referred three to *Orbicella forskalana*, two to *E. ehrenbergi*, and seven excellent examples to *E. fruticulosa*, the largest measuring $34 \times 30 \times 30$ cm.; these latter have incrusting coralla with the typical *gemmacea* facies, but are raised in places into branching hillocks with the *fruticulosa* facies, thus affording conclusive proof that *E. fruticulosa* is only a skeletal variation of *E. gemmacea*.

Localities. Red Sea (13) and broken pieces of *fruticulosa* facies. Also from the Indian Ocean and Seychelles (Milne Edwards and Haime), Dar-es-salaam (Ortmann). A common species in the Red Sea and Indian Ocean.

GALAXEA (OKEN).

1815. *Galaxea* (pars), Oken, Lehrb. Naturg., i, p. 72.
1816. *Sarcinula* (pars), Lamarck, Hist. Anim. sans vert., ii, p. 222.
1816. *Caryophyllia* (pars), Lamarck, Hist. Anim. sans vert., ii, p. 224.
1820. *Anthophyllum* (pars), Schweigger, Handb. Naturg., p. 417.
1834. *Anthophyllum*, Ehrenberg, Corall. roth. Meer., p. 89.
1848. *Sarcinula*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., x, p. 310.
1851. *Galaxea*, Milne Edwards and Haime, Pol. foss. terr. palæoz., etc., p. 70.
1857. *Galaxea*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 223.
1879. *Galaxea*, Klunzinger, Korall. Roth. Meer., ii, p. 77.
1884. *Galaxea*, Duncan, Journ. Linn. Soc. London, Zool., xviii, p. 118.
1899. *Galaxea*, Gardiner, Proc. Zool. Soc. London, Zool., p. 762.
1904. *Galaxea*, Gardiner, Fauna Geogr. Maldives and Laccadives, ii, p. 782.

Corallum. Distinct peritheca between the corallites which pass through it and stand up above its surface, so as to appear quite separate. Peritheca formed of arched vesicles varying from $\cdot 75 \times \cdot 5$ mm. to 2×1 mm., arranged in alternating tiers and appearing like blisters on the surface. Colonies rather massive, but generally much bored into below, this tending to break them up. Corallites from 2 to 8·5 mm. across somewhat conical. Septa generally markedly exsert, sloping obliquely towards a columella formed by their fused ends, almost flat above and dropping somewhat vertically to the costæ, which are only conspicuous near the margins. Orders of septa from 3 to 5.

Polyps. Varying in size. Edge-zones extending over the free surfaces of corallites and continuing as the cœnosarc over peritheca. Mesenteries forming two to four cycles, first two always complete, each of six couples; primaries meeting stomodæum, third cycle sometimes incomplete, the fourth when present incomplete; all with filaments. Tentacles corresponding in number and position with entocœles and exocœles, each with a large

terminal battery and sub-terminal batteries if visible of varying number. Stomodæum short, much compressed laterally; directive grooves deep and narrow. Ovoid bodies* present everywhere in ectoderm excepting in calicoblast; they appear to be degenerate nematocysts of nos. III or I. Entocœlic pleats broad, constricted at their bases and often sub-divided, below stomodæum extending over two-thirds breadth of mesenteries, decreasing in size from skeletal attachments. Entocœlic muscle-bands large. Endoderm of body-wall above enterostome thin, below distended by vacuolation with gradual loss of nuclei, so that it forms at base of polyp a highly reticulated non-nucleated layer, filling up the greater part of the gastro-vascular spaces. Ova in a single longitudinal row in every mesentery. Multiplication by budding usually from cœnosarc, sometimes from edge-zone.

Remarks. In the retracted condition the oral-disc is unevenly raised up by the highly exsert septa and deeply cleft radially by the ingrowth of the latter, leaving only a narrow undivided portion around the slit-like mouth.

Owing to insufficiency of polyp material, I have not been able to determine satisfactorily the relationships of the many recorded species of this genus.

G. bougainvillei (Blain.), *G. pauciradiata* (Blain.), *G. hexagonalis*, Ed. and H., and *G. laperouseana*, Ed. and H., are missing from the Paris Museum, and *Anthophyllum musicale* (Ehrb.) from the Berlin Museum. Without polyps the relationships of Milne Edwards and Haime's four examples of *G. quoyi*, Ed. and H., to the species of *Galaxea* described in this paper cannot be determined. Their corallites are smaller than those of *G. fascicularis* and the corallum is lighter; quinary septa are also wanting.

I have only given the principal characters of Prof. Gardiner's examples of *G. hexagonalis* and *G. laperouseana*, since without polyps it is impossible to determine their respective places in the genus; Milne Edwards and Haime's type specimens of these two species are missing from the Paris Museum.

Distribution.—Red Sea, Indian and Pacific Oceans.

1. *Galaxea fascicularis* (Linnæus). (Pl. **8**, fig. 4; **16**, fig. 4; **38**, fig. 6; **34**, fig. 3; **38**, fig. 6.)

1767. *Madrepora fascicularis*, Linnæus, Syst. Nat., edit. 12, p. 1278.
1786. *Madrepora fascicularis*, Ellis and Solander, Nat. Hist. Zooph., p. 151, pl. 30.
1791. *Madrepora cuspidata*, Esper, Forts. Pflanz., i, p. 155, pl. 28, figs. 1 and 2.
? 1791. *Madrepora fascicularis*, Esper, Forts. Pflanz., i, p. 157, pl. 29, figs. 1 and 2.
1815. *Galaxea fascicularis*, Oken, Lehrb. Naturg., i, p. 73.
1815. *Galaxea cuspidata*, Oken, Lehrb. Naturg., i, p. 73.
1816. *Caryophyllia fasciculata*, Lamarck, Hist. Anim. sans vert., ii, p. 226,—2e édit., p. 349.
1818. *Caryophyllia fasciculata*, Blainville, Dict. Sci. Nat,, vii, p. 194.
1834. *Anthophyllum fasiculare*, Ehrenberg, Corall. roth. Meer., p. 89.
1846. *Anthophyllum cuspidatum*, Dana, Expl. exp. Zooph., p. 401.
1846. *Anthophyllum hystrix*, Dana, Expl. exp. Zooph., p. 401, pl. 28, fig. 2.
1848. *Sarcinula fascicularis*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., x, p. 313.

* Prof. Bourne (15, p. 531, fig. 30) has used the term "ovoid bodies" to somewhat similar structures in the calicoblastic ectoderm of *Caryophyllia smithii*, which he regarded as degenerate nematocysts. If these bodies and the ones recorded above are homologous, it is noteworthy that the latter should be absent everywhere from the calicoblast of the two species of *Galaxea*, whose polyps I have studied.

1848. *Sarcinula ellissii*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., x, p. 315.
? 1848. *Sarcinula irregularis*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., x, p. 316.
1848. *Sarcinula hystrix*, Milne Edwards and Haime, Ann. Sci. Nat., 3e sér., x, p. 318.
1851. *Galaxea fascicularis ellisi* and *irregularis*, Milne Edwards and Haime, Pol. foss. terr. palæoz., etc., p. 71.
1857. *Galaxea fascicularis*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 227.
1857. *Galaxea ellisi*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 228.
? 1857. *Galaxea irregularis*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 229, pl. D2, fig. 2*a* and *b*.
1877. *Galaxea fascicularis*, Studer, Monat. Ak. Wiss. Berlin, p. 637.
1877. *Galaxea cespitosa*, Studer, Monat. Ak. Wiss. Berlin, p. 637.
1879. *Galaxea fascicularis*, Klunzinger, Korall. Roth. Meer., ii, p. 78.
? 1879. *Galaxea irregularis*, Klunzinger, Korall. Roth. Meer., ii, p. 78, pl. 7, fig. 11.
1886. *Galaxea aspera*, Quelch, Reef Corals, Challenger Reports, Zool., vol. xvi, pt xlvi, p. 72, pl. 4, figs. 5—5*d*.
1886. *Galaxea ellisii*, Quelch, Reef Corals, Challenger Reports, Zool.. vol. xvi, pt xlvi, p. 72.
1899. *Galaxea fascicularis*, Gardiner, Proc. Zool. Soc., p. 763.
1904. *Galaxea fascicularis*, Gardiner, Fauna Geogr. Maldives and Laccadives, ii, p. 783.
1906. *Galaxea irregularis*, Marenzeller, Exp. "Pola," Rot. Meer., Riffkorall., Zool. Ergeb. Wien, xxvi, p. 54.

Corallum. Perithecal vesicles small, ·75×·5 mm. in size, usually open on surface. Corallites circular or oval in outline, projecting above peritheca to 15 mm. or possibly more, decreasing in diameter from calicular opening (8·5 mm.) to peritheca (5 mm.), 1—2·5 mm. apart, diverging upwards from peritheca; walls ·75 mm. thick towards bases, thinning to the free margins. Largest calices when round 8 mm. in diameter, when oval 9×6 mm.; depth from calicular opening to columella 3 mm.

Septa in five orders, the first four complete, the fifth incomplete, very narrow, maximum number ten, hence most of the quaternaries exocœlic; septa exsert vertically, sides smooth, edges entire, sharp; primaries thicker than secondaries, both exsert for 2—3 mm., not swollen in thecæ, and meeting columella. Tertiaries with edges bent towards and united with sides of secondaries, sometimes extending near to columella; quaternaries occasionally fused with sides of tertiaries, both exsert to 1 mm. Costæ smooth, seen as low sharp ridges in upper third of corallite-wall, below as striæ. Columella poorly developed, primary and secondary septa almost meeting in centre (as in *Baryastrea transversa*). Budding near the edge of corallum from peritheca.

The smallest corallite measured 5·5 mm. in height and 3 mm. in diameter, with three complete orders of septa, the primaries and secondaries meeting columella.

Polyps. (1) Size corresponding with corallites. (2) Entocœlic tentacles as well developed as exocœlic; terminal batteries with thickened ectoderm and closely packed nematocysts; sub-terminal batteries well defined, up to thirty or thirty-five. (3) Exocœlic tentacles similar. (4) Quaternary couples of mesenteries present, cycle incomplete. (5) Ectoderm of outer wall of edge-zone and oral-disc about the same thickness. (6) "Ovoid bodies" numerous. (7) Algæ not very abundant.

Remarks. A. *Polyps.* Quaternary couples of mesenteries in the two large polyps sectioned numbered 0, 0, 0, 3, 0, 2 and 0, 3, 2, 1, 2, 3. The convolutions of mesenteries are massed together in the inter-mesenteric chambers for some distance below the stomodæum, but scarce towards the base of the polyp. The stomodæum with lumen distinct, diameters 2×·75 mm. In some of the "ovoid bodies" a thick central core with a faint spiral around it is visible, suggestive of degenerate nematocysts III. The calicoblast is thickened near the skeletal attachments of the mesenteries about the thickness of the

ectoderm of the outer wall of the edge-zone. The ectoderm of the oral-disc is thick with nuclei massed together in its lower half, ovoid bodies rare, nematocysts I and II*b* frequently present. In the upper half of the ectoderm of the outer wall of the edge-zone nuclei are arranged in layers with numerous mucous vacuoles and nematocysts I and II. In the terminal batteries, nematocysts II*b* are more numerous than I, the latter with up to 30 turns of the spiral. Ovoid bodies absent, but present in the sub-terminal batteries. Mucous vacuoles stain orange with hæmatoxylin and eosin as in *Leptastrea roissyana*, Ed. and H., in contrast to species where the colour is brown. The stomodæal ridges are as broad as or broader than thick, nuclei massed together towards the lumen and ovoid bodies towards the mesoglæa; nematocysts absent. Filaments are well developed on primary and secondary mesenteries, rudimentary on rest; nematocysts are scarce in their straight regions, but I and II occur in small numbers in the coils. The mesenterial mesoglæa thickens near the stomodæum, on this part exocœlic fibres being better developed. The endoderm in the oral-disc and in the body-wall above the enterostome is thin, and contains a few algæ; it is much thickened in the outer wall of the edge-zone, thin in its inner wall; in the tentacles it is as thick as the ectoderm of the sub-terminal batteries, and algæ are more abundant in the entocœlic than in the exocœlic tentacles; over the mesenteries the endoderm is comparatively thin, except near the stomodæal attachments of the primaries.

Gonads were not present in the polyps examined.

Polyps examined, three; from two colonies from the Red Sea. One of these was a young polyp 4 mm. in height and 2 mm. in diameter, in which only four tertiary couples had appeared.

B. *Corallum.* The corallum of this species is apparently very variable. Most of the examples of *G. irregularis*, Ed. and H., that I have examined differ from my specimen, whose polyps were sectioned in having larger corallites, which are laterally compressed or distorted. The appearance suggests that the large size and the distortion might be due to a somewhat retarded fission, but, of course, this can be ascertained only by an examination of the polyps.

The specimens referred by Prof. Gardiner to *G. fascicularis* form a somewhat heterogeneous lot, one of them approaching *G. musicalis* in appearance. They differ from the specimen on Pl. **16**, fig 4, in the following respects: (1) primary and secondary septa of almost equal thickness and more highly exsert, up to 4 mm.; (2) primaries swollen in thecæ but thinner in calices; (3) costæ more prominent; (4) columella better developed; (5) corallites often irregularly compressed, tending to be sub-triangular in outline and with thicker walls. In other words, they have more or less the *irregularis* facies.

Milne Edwards and Haime have referred nine specimens in the Paris Museum to *G. fascicularis*, of which four are in Lamarck's collection, and four others to *G. irregularis*; an example of each of these species resembles my figured specimen. The same authors have assigned three specimens to *G. ellisi*; the same name is written on four specimens of Rousseau's and one of Agassiz's.

Of the four examples in the Berlin Museum named *Anthophyllum fasciculare* by Ehrenberg, No. 624 (12 × 7 cm., Pl. **38**, fig. 6) is identical with my figured example; the

remaining three have much larger corallites, usually compressed or distorted, which Klunzinger later referred to *G. irregularis*, Ed. and H. Resembling these latter are two of the "Gazelle" specimens referred by Studer to *G. fascicularis*. The large examples Studer referred to *G. cespitosa*, Dana, have corallites of the same shape and size as in my figured type, but the septa are rougher.

Marenzeller has named twenty-one specimens of the "Pola" expedition *G. irregularis*, of which eight are numbered. No. 15898 resembles my type in every respect; in the remaining ones the corallites are larger and distorted. In one of the unnumbered specimens from Massawah some of the corallites are exactly as in my figure, while others have the *irregularis* facies.

In the Copenhagen Museum is a single rubbed specimen, doubtfully regarded as Forskål's original of *Madrepora divergens*; its characters are beyond recognition. Ellis and Solander's figured type of *Madrepora fascicularis* is missing from the Glasgow University Museum, but their figure resembles my specimens from the Red Sea.

Quelch's type of *G. aspera* from Amboina measures $9 \times 6 \times 9$ cm.; a fifth septal cycle is wanting in the corallites, while the fourth is incomplete, but these differences are to be attributed to the smallness of the specimen. His example of *G. ellisii*, Ed. and H., from Mactan Island, Philippines, has somewhat the *irregularis* facies, many of the corallites being laterally compressed, with 15—17 septa meeting the columella. The place of his type ($9 \times 8 \times 5$ cm.) of *G. fragilis* from Amboina is more doubtful; its corallites are smaller and thinner (both walls and septa) than in his type of *G. aspera*, but are wider apart, perithecal vesicles larger, costæ prominent and sides of septa rough.

A specimen ($10 \times 7 \times 7$ cm.) from Ponape, named *Galaxea tenella*, Brügg., sent from the Hamburg Museum, and now in the British Museum, is perhaps only a variety of *G. fascicularis*; the corallites are close together, the septa in five cycles (fifth incomplete), up to eighteen meeting the columella.

Localities. Red Sea (8 large, some with the *irregularis* facies and a few small ones). Aldabra, Lagoon Reef (6, mostly with the *irregularis* facies). Saya de Malha (1, with the *irregularis* facies from 26 fms.). Also from Seychelles (Milne Edwards and Haime), Fiji Islands (Dana), Amboina and Philippines (Quelch), Ponape (Brüggemann), loc. ? (Ellis and Solander), China Seas (Esper).

2. *Galaxea musicalis* (Linnæus). (Pl. **16**, figs. 2 and 3.)

? 1767. *Madrepora musicalis*, Linnæus, Syst. Nat., edit. 12, p. 1278.
1791. *Madrepora musicalis* (pars), Esper, Forts. Pflanz., p. 160, pl. 30, fig. 1.
1815. *Galaxea musicalis*, Oken, Lehrb. Naturg., i, p. 73.
1816. *Caryophyllia musicalis*, Lamarck, Hist. Anim. sans vert., ii, p. 227; 2e édit., p. 350.
1817. *Caryophyllia musicalis*, Blainville, Dict. Sci. Nat., vii, p. 195.
1830. *Sarcinula musicalis*, Blainville, Dict. Sci. Nat., lx, p. 314; Manuel d'Actinol., p. 348.
1848. *Anthophyllum musicale*, Dana, Expl. exp. Zooph., p. 399.
1848. *Sarcinula musicalis*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., x, p. 312.
1848. *Sarcinula erecta*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., x, p. 317.
1851. *Galaxea musicalis* and *clavus*, Milne Edwards and Haime, Pol. foss. terr. palæoz., etc., pp. 70 and 71.
1857. *Galaxea musicalis*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 225.
1857. *Galaxea clavus*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 232.
1889. *Galaxea heterocyathus*, Ortmann, Steinkorall, Süd. Ceylons, Zool. Jahrb., iv, p. 534, pl. 16, fig. 12.
1904. *Galaxea musicalis*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 783.

Corallum. Perithecal vesicles slightly larger than in *G. fascicularis*; usually closed on surface. Corallites oval or circular, much smaller than in last species, projecting above peritheca up to 3·5 mm., of even diameter or somewhat increasing from calicular opening to peritheca, up to 5 mm. apart, usually 3 mm., not so diverging as in last. Walls of about same thickness. Calices with diameters 4 × 3 mm., depth 1·75 mm.

Septa in four orders, the first three complete, the fourth incomplete, maximum number 13, hence most of the tertiaries exocœlic; septa exsert vertically, sides rough, edges entire sharp, primaries usually thicker than secondaries, both exsert to 1·5 mm., swollen in thecæ and meeting columella. Tertiaries with edges free and exsert to 1·5 mm. Costæ smooth, seen as sharp ridges along almost the whole projecting part of corallite-wall. Columella distinct, circular or oval in outline, about ·75 mm. broad, sometimes laterally compressed and septa meeting above it. Budding from any part of peritheca.

Polyps. (1) Size small, corresponding with corallites. (2) Entocœlic tentacles much less differentiated than exocœlic; terminal batteries with loosely arranged nematocysts, not swollen; sub-terminal batteries not defined, with numerous nematocysts. (3) Exocœlic tentacle with up to about twelve sub-terminal batteries. (4) Quaternary couples of mesenteries absent. (5) Ectoderm of outer wall of edge-zone not more than half the thickness of oral-disc ectoderm. (6) "Ovoid bodies" fewer than in *G. fascicularis*. (7) Algæ much more abundant than in *G. fascicularis*.

Remarks. A. *Polyps.* The tertiary cycle of mesenteries was incomplete, the couples being 6, 3 and 1 in the three polyps examined. One of the polyps was abnormal in possessing a third couple of directives. The exocœlic tentacles are somewhat bluntly pointed. The primary septa press against the stomodæum near the enterostome, greatly distorting its wall and almost occluding its lumen; if this means an imperfect functional capacity, as I am disposed to suggest, it is correlated with a great abundance of algæ. The ectoderm of the oral-disc is thick, with numerous nematocysts I and a few of II. Ovoid bodies are scarce in both the oral-disc and edge-zone; some of them are narrower than in *G. fascicularis*, with no central core but with traces of a spiral suggesting degenerate nematocysts I. In the terminal batteries of exocœlic tentacles, nematocysts II *b* are less numerous than in the last species. Ovoid bodies are present in the sub-terminal batteries. The stomodæal ridges are not so thick as in the last species. In the coils of the mesenterial filaments nematocysts I are more numerous. Entocœlic pleats are broader and thicker than in *G. fascicularis*, and tend to arise in groups of three or four, the pleats of each group often fusing at their bases to form thick compound ridges. The endoderm in the oral-disc is thicker than in the last species, and is massed with algæ; it is much thinner in the outer wall of the edge-zone, considerably thickened in the tentacles owing to vacuolation, and filled with algæ, occluding the lumen in the region of the terminal batteries of the exocœlic tentacles. The mesenterial endoderm is somewhat thicker on the exocœlic side where algæ are massed together.

The polyps examined were ripe females. The eggs are carried in a single row on the exocœlic side of every mesentery, in transverse section each egg almost fitting the exocœle. The appearance of a double row of eggs is sometimes presented, owing to either the overlapping of neighbouring eggs or to the eggs of adjacent mesenteries being

accommodated in the exocœle, one in front of the other. Small immature ova are present in the endoderm surrounding the eggs.

Polyps examined, six, from a dredged specimen from Maldives.

B. *Corallum.* Milne Edwards and Haime's type of *G. musicalis*, which was perhaps Lamarck's type of *Caryophyllia musicalis*, is a small rubbed specimen. Of their three examples of *G. clavus*, one is equally damaged, but the two others resemble my examples of the present species.

Ortmann's figured type of *G. heterocyathus* is a long, somewhat cylindrical specimen, measuring 23 × 16 cm.

Quelch's recorded example (11 × 9 cm.) of *G. musicalis* from Somerset, Cape York, has corallites with broken margins. A specimen (7 × 7 × 4 cm.) from Kandavu and another (4·5 × 4·5 cm.) from Amboina, which he referred to *G. fascicularis* and *G. tenella*, Brügg., respectively, come under the present species in size of corallites, number and roughness of septa, thickness of columella, etc.

Localities. Maldives (3). Coin, Peros (1). Also from Fiji (Milne Edwards and Haime and Quelch); Ceylon (Ortmann), Torres Strait and Amboina (Quelch).

3. *Galaxea lamarcki*, Milne Edwards and Haime. (Pl. **13**, fig. 6; **16**, fig. 1; **34**, fig. 2.)

? 1766. *Madrepora organum*, Pallas, Elench. Zooph., p. 317.
? 1815. *Galaxea organum*, Oken, Lehrb. Naturg., i, p. 73.
1816. *Sarcinula organum*, Lamarck, Hist. Anim. sans vert., ii, p. 223; 2e édit., p. 241 (non *Madrepora organum*, Linnæus).
1816. *Caryophyllia astreata*, Lamarck, Hist. Anim. sans vert., ii, p. 227; 2e édit., p. 250.
1830. *Sarcinula astreata*, Blainville, Dict. Sci. Nat., lx, p. 314; Manuel d'Actinol., p. 348.
1834. *Anthophyllum sphærula*, Ehrenberg, Corall. roth. Meer., p. 89.
1848. *Sarcinula organum*, Milne Edwards, Atlas grande édit. Règne Anim. Cuvier, Zooph., pl. 85, fig. 1
1848. *Sarcinula organum*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., x, p. 311.
1848. *Sarcinula astreata*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., x, p. 317.
1851. *Galaxea lamarcki* and *astreata*, Milne Edwards and Haime, Pol. foss. terr. palæoz., etc., pp. 70 and 71.
1857. *Galaxea lamarcki*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 225.
1857. *Galaxea astræata*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 230.
1879. *Galaxea lamarcki*, Klunzinger, Korall. Roth. Meer., ii, p. 77.
1886. *Galaxea explanata*, Quelch, Reef Corals, Challenger Reports, Zool., vol. xvi, pt. xlvi, p. 71, pl. 4, figs. 6—6*d*.
1904. *Galaxea lamarcki*, Gardiner, Fauna Geogr. Maldives and Laccadives, ii, p. 783.
1904. *Galaxea*, sp.? Gardiner, Fauna Geogr. Maldives and Laccadives, ii, p. 783.

Corallum. Perithecal vesicles larger than in any previous species, up to 2 × 1 mm.—hence corallum very light—closed on surface. Corallites always round, smaller than in all other species, less projecting, maximum 2 mm., 2—4 mm. apart. Walls up to ·5 mm. thick. Calices usually 2 mm. in diameter, maximum 3 mm. Septa in three orders, sides rough, edges entire; usually primaries only meeting columella, exsert up to 1 mm., secondaries thinner, sometimes varying in number, rarely all the six reaching columella. Costæ inconspicuous. Columella circular in outline, distinct. Budding from any part of peritheca.

Polyps useless for any detailed study. Two were sectioned from specimen from S. Nilandu (36 fms.) and one from another specimen from Peros (16 fms.).

Remarks. There is no doubt that this is a distinct species. The small piece from

Felidu, about whose identity Prof. Gardiner was uncertain, is only a skeletal variety of *G. lamarcki*, differing from the latter in having less projecting corallites and indistinct columella.

The five small specimens referred by Milne Edwards and Haime to *G. lamarcki*, perhaps originally Lamarck's examples of *Sarcinula organum*, are all much defaced. Of their three examples of *G. astreata*—all of which are in good condition—one is in Lamarck's collection, being probably his original of *Caryophyllia astreata*.

Ehrenberg's type of *Anthophyllum sphærula* is a small round specimen in bad condition, but of its place in the present species there is no doubt.

Quelch's large type (21 × 10 cm.) of *G. explanata* resembles my examples of *G. lamarcki* in possessing only three septal cycles, the primaries and most of the secondaries meeting columella, and large perithecal vessels, but the corallites project much higher and are further apart; the primaries are thicker than the secondaries and have more prominent costæ.

Localities. Maldives: Nilandu, 36 fms. (1); Felidu, 25 fms. (1). Chagos: Diamont, Peros, 16 fms. (1); Coin, Peros (1). Saya de Malha, 29 fms. Also from Red Sea (Ehrenberg and ? Lamarck), Fiji (Quelch).

4. *Galaxea hexagonalis* (Ed. and H.) (?).

Galaxea hexagonalis, Gardiner, Fauna Geogr. Maldives and Laccadives, 783 (1904).

Perithecal vesicles small. Corallites smaller than in *G. fascicularis*, irregularly compressed, becoming sub-triangular in outline, projecting to 9 mm., 1—2 mm. apart. Walls thin. Largest calyx 8 × 5 mm. Septa in four orders, the fourth incomplete—up to 19—sides with short spines, edges denticulate; about 15 septa meeting columella; secondaries as thick as primaries; tertiaries exsert obliquely outwards. Costæ prominent, raised into short spines at wide intervals. Columella distinct. Budding towards edge of corallum from peritheca, sometimes towards bases of corallites. Sometimes two corallites fuse, in appearance simulating fission.

The polyps are too badly preserved to make out their specific characters.

Locality. Minikoi. Milne Edwards and Haime's type specimens are missing from the Paris Museum.

5. *Galaxea laperouseanea* (Ed. and H.) (?).

Galaxea laperouseanea, Gardiner, Proc. Zool. Soc., 1899, 762.

Perithecal vesicles small. Corallites oval or sub-triangular, projecting to about 7 mm., 1—2 mm. apart. Walls up to 2 mm. thick. Largest calyx 10 × 5 mm. Septa in four orders, up to 14 quaternaries, sides slightly rough, edges entire, about 17 septa meeting columella; secondaries usually as thick as primaries, both swollen in thecæ and exsert vertically; tertiaries exsert obliquely outwards, hence their costæ appearing more prominent than those of primaries and secondaries. Columella distinct. Budding near edge of corallum from peritheca.

The coralla are denser than those of other species of *Galaxea*, with corallites wider, walls and septa thicker.

No polyps.

Locality. Rotuma (2). Milne Edwards and Haime's type specimens of this species are missing from the Paris Museum.

LEPTASTREA (Milne Edwards and Haime).

1848. *Leptastrea*, Milne Edwards and Haime, Compt. rend. l'Acad. Sci., xxvii, p. 494.
1848. *Baryastrea*, Milne Edwards and Haime, Compt. rend. l'Acad. Sci., xxvii, p. 495.
1857. *Leptastræa*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 493.
1857. *Baryastræa*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 512.
1879. *Leptastræa* (pars), Klunzinger, Korall. Roth. Meer., iii, p. 43.
1884. *Leptastræa*, Duncan, Journ. Linn. Soc., London, Zool., xviii, p. 119.
1884. *Baryastræa*, Duncan, Journ. Linn. Soc. London, Zool., xviii, p. 119.
1886. *Leptastræa*, Quelch, Reef Corals, Challenger Reports, Zool., vol. xvi, pt. xlvi, p. 108.
1899. *Orbicella* (pars), Gardiner, Proc. Zool. Soc. London, p. 751.
1901. *Leptastræa*, Studer, Zool. Jahrb., xl, p. 402.
1904. *Orbicella* (pars), Gardiner, Fauna Geogr. Maldives and Laccadives, ii, p. 774.

Corallum. Incrusting, convex or round, sometimes raised into hillocks, dense and usually heavy. Corallites polygonal, oval or round, not projecting or at most up to 1·75 mm., one side usually more than the other, arranged close together with little or no peritheca, as a rule separated on the surface by narrow furrows, which are always polygonal around corallites. Walls fused, dense, varying from ·5 to 3 mm. in thickness. Calices oval, round or polygonal, sometimes laterally compressed and distorted, varying considerably in diameter in the same specimen from 2 to 5·5 mm. and in depth from almost flat up to 3·6 mm. Septa in four orders, the first three always complete, upper margins usually flat, primaries meeting columella; the fourth order complete or incomplete, sometimes a few quinaries, last order exocœlic. Costæ seen as low flat ridges when corallites project. Columella varying from very thin to a third or half the width of calices. Calicular dissepiments horizontal or somewhat oblique, about ·75 or 1 mm. apart. Giant corallites present.

Polyps. Oval or circular, upper margins somewhat polygonal, varying in size. Edge-zones absent when corallites do not project, and little or no intervening cœnosarcal regions owing to close approximation of corallites. Mesenteries in three or four cycles, the first two of six couples each, the third when complete of twelve couples but often incomplete, quaternaries when present few in number; all with filaments. Tentacles corresponding in number and position with entocœles and exocœles. Stomodæum short, usually compressed laterally, with narrow directive grooves. Entocœlic pleats similar in general shape to those of *Galaxea* but less broad and only a few sub-divided. Multiplication by budding.

Remarks. This genus comes nearer *Galaxea* than any other described genera, as may be seen from the following comparison of *L. roissyana* and *G. musicalis*. (1) The terminal batteries of entocœlic tentacles are feebly developed in both species, with neither thickened ectoderm nor closely-packed nematocysts, whereas those of the exocœlic tentacles are well defined with nearly the same shape and relative size. (2) The endoderm of exocœlic tentacles is so much distended as to fill their lumina in the regions of the terminal batteries. (3) The stomodæum is much compressed laterally and its wall distorted by the ingrowth of septa. (4) Tertiary couples of mesenteries present. (5) The

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entocœlic pleats have the same general shape and distribution in both species, broad but constricted at the base, hence appearing knobbed in transverse section, sub-divided usually in *G. musicalis*, exceptionally in *L. roissyana*. (6) The mesenterial endoderm is comparatively thin. (7) The great abundance of algæ.

There are, however, some important differences between the two species, viz.: (1) The general appearance of the colonies is strikingly different in the two cases; in *L. roissyana* the corallites are close together and almost level with the general surface, in *G. musicalis* they are wider apart and project above the peritheca. (2) Peritheca dense in *L. roissyana*, highly vesicular in *G. musicalis*, the vesicles with thin walls. (3) "Ovoid bodies" are always met with in the ectoderm of *G. musicalis*, their presence being quite diagnostic of *Galaxea*; they are absent from *L. roissyana*.

The "Challenger" examples of *Leptastrea* available for examination were all small spirit specimens. Owing to the presence of soft tissues on them, it was impossible to compare them with the continental types, but there is little doubt that most of Quelch's determinations were wrong.

Distribution. Red Sea, Indian and Pacific Oceans.

1. *Leptastrea roissyana*, Milne Edwards and Haime. (Pl. **8**, figs. 1—3; **17**, fig. 4; **18**, fig. 1; **19**, figs. 1 and 2; **37**, fig. 4.)

1850. *Leptastrea roissyana*, Milne Edwards and Haime, Ann. Sci. Nat., 3e sér., x, pl. 9, figs. 6 and 6*a*, and xii, p. 120.
1857. *Leptastræa roissyana*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 494.
1879. *Leptastræa transversa*, Klunzinger, Korall. Roth. Meer., iii, p. 46, pl. 6, fig. 2.
1904. *Orbicella ehrenbergana* (pars), Gardiner, Fauna Geogr. Maldives and Laccadives, p. 776.

Corallum. Incrusting or massive and convex, rarely rising into humps. Intercorallite furrows usually distinct, the exsert ends of septa ending at their margins, rarely absent, leaving a sharp ridge over which septa become continuous. Corallites not projecting. Walls about ·35 mm. thick, sometimes up to 1 mm. towards edge of corallum. Calices oval or polygonal, widest at their margins, with diameters about 4 and 3·6 mm., depth to columella 2·6—3·6 mm.

Septa swollen in thecæ, thin in calices, with sides smooth, edges entire, in not more than four orders, the first three always complete; primaries slightly broader than secondaries, both meeting columella, with somewhat oblique margins and exsert to ·5 mm. The fourth order often incomplete, usually of about 10 very narrow septa, hence some of the tertiaries exocœlic; tertiaries often curve towards and meet sides of secondaries near to columella. Columella much compressed laterally, indistinct, primary and secondary septa almost meeting in the centre and forming with the two directive septa a transverse partition across calyx.

Young corallites formed by budding are seen intercalated among the larger ones.

Polyps. About 4 mm. in height, with margins somewhat polygonal. Mesenteries in three cycles; primaries of six couples all meeting the stomodæum; secondaries of an equal number from half to two-thirds the width of the former; tertiaries from 2—8 couples; all with filaments in whose coils nematocysts II are common and III rare. Convolutions of mesenteries massed together in inter-mesenteric chambers to some distance below

stomodæum, not abundant at the bases of polyps. The terminal battery of each entocœlic tentacle swollen but without much thickening of ectoderm, and nematocysts I and II *b* mostly restricted to its tip; the exocœlic terminal battery well formed with thickened ectoderm and nematocysts closely packed; 3—5 very small sub-terminal batteries; mucous vacuoles* found close together in all batteries, between which lie rod and spindle-shaped nuclei homogeneously stained dark; granular vacuoles also present. Stomodæum much compressed laterally; its ridges narrow with no nematocysts.

Entocœlic pleats present in outer half of primary mesenteries in the stomodæal region of polyps, best developed in outer one-third, broad and constricted at their bases, hence appearing knobbed in transverse section, occasionally sub-divided, below stomodæum extending over two-thirds width of mesentery. Mesenterial mesoglæa slightly thickened near stomodæal attachment, elsewhere thin.

Ectoderm of oral-disc with columnar facies resembling that of *C. chalcidicum*. Endoderm of body-wall thin above enterostome, with few algæ and many transparent vacuoles, below becoming reticulated and consequently distended; tentacular endoderm hardly visible owing to aggregation of algæ, sometimes blocking lumen of exocœlic tentacle in the region of its terminal battery; endoderm of primary mesenteries somewhat thickened near their stomodæal attachments, behind filaments appearing pad-like in transverse section, elsewhere thin; algæ massed together in exocœlic side. Stomodæal endoderm extremely thin.

Polyps examined, ten, 4 from one and 3 from a second specimen from Red Sea, 1 from a specimen from Salomon† and 2 from a specimen from Ceylon.

Remarks. *Corallum.* Milne Edwards and Haime's type of *L. roissyana* (locality unknown) is a large specimen measuring $25 \times 20 \times 17$ cm. It is peculiar in that the corallum has incrusted over projecting calcareous tubes of some polychæte worms; consequently the corallites have undergone some modification in shape—most of them project slightly, some almost circular, a few drawn out; on the general substratum, the corallites have the usual polygonal shape. As in my examples the septa are never in more than four orders, but in many corallites more than twelve septa—up to thirteen—meet the columella.

In the Berlin Museum are two specimens, referred by Klunzinger to *L. transversa*, one large and flat, measuring 24×12 cm., the other small, both entirely resembling my type specimens of the present species. Identical with these is another small specimen referred by the same author to *L. immersa*.

Localities. Red Sea (16 specimens). Chagos, Salomon (7). Maldives: Hulule (3); Goidu (1); Addu (1). Minikoi (3). Ceylon (small specimens). Not known from the Pacific.

2. *Leptastrea ehrenbergana*, Milne Edwards and Haime. (Pl. **17**, figs. 5—7; **18**, figs. 2 and 7; **19**, figs. 3 and 4; **34**, fig. 8.)

1850. *Leptastrea ehrenbergana*, Milne Edwards and Haime, Ann. Sci. Nat., 3e sér., xii, p. 120.

* Mucous vacuoles stain orange with hæmatoxylin and eosin as in *Galaxea*.

† The polyps of this specimen were in a bad state of preservation; in the one sectioned a few disconnected ova were found.

1857. *Leptastræa ehrenbergana*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 494, pl. D 7, fig. 4.
1879. *Leptastræa ehrenbergana*, Klunzinger, Korall. Roth. Meer., iii, p. 46, pl. 6, fig. 3.
1899. *Orbicella klunzingeri*, Gardiner, Proc. Zool. Soc. London, p. 755.
1904. *Orbicella ehrenbergana* (pars), Gardiner, Fauna Geogr. Maldives and Laccadives, ii, p. 776.

Corallum. Incrusting or rounded and completely covered with corallites, sometimes rising into humps. Inter-corallite furrows shallower and less distinct than in *L. roissyana*, sometimes absent, septa then meeting over walls in ridge-form. Corallites not projecting, the larger ones usually laterally compressed and distorted, widest at their margins, showing considerable variation in size in different parts of the same specimen, often much larger in certain regions (usually eminences) than in others (valleys). Walls much thicker than in the last species, up to 1·5 mm., usually about ·75 mm. Calices oval or polygonal, from 2—5·6 × 5 mm. in diameter, average 4·5 × 4 mm., depth up to 3·6 mm.

Septa appearing crowded in calices, not swollen in thecæ, somewhat thicker in calices than in *L. roissyana*, usually less exsert, sides granular, edges denticulate, in four or sometimes five orders. Primaries broader than secondaries above columella, both with almost vertical margins; these and often a varying number of tertiaries (up to 10), usually 4 or 5, meeting columella, remaining tertiaries as a rule curving towards and their edges fusing with sides of secondaries near to columella; up to 6 quinaries present, all the quaternaries being then entocœlic. Columella dense up to 2 × 1·6 mm. thick, often with conspicuous upright rods.

A thicker and rougher species than *L. roissyana*. Occasionally cases of fusion of two corallites, giving an appearance of fission.

No polyps.

Remarks. Milne Edwards and Haime's original of *L. ehrenbergana* from Red Sea, in the Paris Museum, is a massive specimen, measuring 15 × 5 × 12 × 11 cm. with typical corallites, being identical with specimen no. 9 on p. 71. Resembling these in the Berlin Museum are Klunzinger's small figured example (7 × 6 cm.) of the same species and a large specimen from Dar-es-Salaam, referred by Ortmann to *L. immersa*, Klunz.

Localities. Red Sea (5). Maldives: Hulule (1); Goidu (1); Turadu (1). Minikoi (3 and broken pieces). Chagos: Salomon (4); Egmont (1). Rotuma (1). Funafuti (1). Also from Dar-es-Salaam (Ortmann).

3. *Leptastrea solida* (Milne Edwards and Haime). (Pl. **17,** figs 8 and 9; **18,** figs 3—6 and 8; **19,** figs 5 and 6.)

1850. *Cyphastrea? bottæ* (pars), Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 115.
1850. *Baryastrea solida*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 144.
1857. *Cyphastræa bottai* (pars), Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 486, pl. D 7, fig. 1 (not "grandeur naturelle" but an enlarged view).
1857. *Baryastræa solidæ*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 512, pl. D 8, fig. 2*a* and *b*.
? 1860. *Chypastrea oblita*, Duchassaing and Michellotti, Mémoire Corall. Antill. Turin, p. 77.
1879. *Leptastræa bottai*, Klunzinger, Korall. Roth. Meer., iii., p. 44, pl. 5, fig. 9, pl. 10, fig. 13 *a* and *b*.
1879. *Leptastræa inæqualis*, Klunzinger, Korall. Roth. Meer., iii, p. 45, pl. 5, fig. 6.
1904. *Orbicella bottai*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 777, pl. 63, fig. 36.

Corallum. Variations in growth-form as in *B. ehrenbergana*. Inter-corallite furrows distinct, rarely absent, in which case wall flat with septa continuous over same. Corallites usually round, sometimes polygonal or oval, projecting to about 1 mm., maximum

2 mm., usually one side higher than the other. Wall ·75 mm. thick. Calices on the whole smaller than in the two previous species but of uniform width from margins to bases, average diameter 3 mm., depth 2 mm.

Septa usually thicker in calices than in *B. ehrenbergana*, exsert to ·75 or 1 mm. Sides with short spines, in three complete orders, quaternaries absent or up to 6. Primaries usually thicker than secondaries, both—often also 1 to 3 tertiaries—meeting columella ; septal edges vertical, each usually with a paliform lobe near the columella either upright or directed obliquely inwards with sometimes an additional blunt tooth or two above it. Costæ as low flat ridges. Columella thicker than in *B. ehrenbergana*, from a third to half the width of calices, with sometimes short rods.

Giant corallites 4—4·6 mm. in, diameter with from 16—22 septa meeting columella, frequently found among the normal ones (Pl. **18**, figs. 5 and 6). Occasionally two corallites fuse, presenting an appearance of fission (Pl. **18**, fig. 4).

No polyps.

Remarks. *Corallum.* Milne Edwards and Haime's smaller figured example of *Cyphastræa bottai* is massive, measuring 11·5 × 10 × 8 cm. (Pl. **18**, fig. 8). Its calices range up to 3 mm. in diameter (average 2—2·5 mm.); the six primary septa in each corallite are thicker than the secondaries, the former and a varying number of the latter meeting the columella from which short rods project; on the whole it resembles specimen no. 15 on p. 71. But, as the second larger example referred by Milne Edwards and Haime to the same species is a true *Cyphastræa* (most probably *C. serailia*), the specific name *bottai* cannot be given to the present species. Unfortunately Milne Edwards and Haime's type of *Baryastræa solida* is missing from the Paris Museum, but since the two figures agree completely with my type specimens I have applied the name *solida* to the present species.

A specimen (13 × 8 × 9 cm.) from St Thomas in the Paris Museum named *Chypastrea oblita* by Duchassaing comes near the present species. Its chief characters are as follows: peritheca vesicular, with spines; calices circular up to 3 mm. in diameter, average 2·5 mm.; septa in three orders of 6, 6 and 12, primaries and secondaries in every corallite meeting columella, each dropping vertically for the greater part of its height, then passing obliquely or horizontally inwards to meet columella, the latter region of septum with 3—5 conspicuous blunt teeth; primaries somewhat thicker than secondaries; columella with short rods.

Klunzinger's figured example (12 × 12 × 7 cm.) of *L. bottai* has no paliform lobes; in each corallite both primary and secondary septa meet the columella with which twelve tertiaries alternate; a few giant-corallites are present. Resembling this are his figured type (8 × 7 cm.) of *L. inæqualis* and another small specimen from Koseir in the Paris Museum, to which Klunzinger has given the same name.

Localities. Red Sea (6). Maldives: Hulule (3); Goidu (2). Minikoi (8). Chagos, Salomon (12). ? Also from St Thomas (Duchassaing and Michellotti).

4. *Leptastrea ? immersa*, Klunzinger.

1879. *Leptastræa immersa*, Klunzinger, Korall. Roth. Meer., iii, p. 47, pl. 6, fig. 1.
1904. *Orbicella immersa*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 776.

LIST OF SPECIMENS SHOWING THE EXTENT OF VARIATION IN THE GENUS *LEPTASTREA*.

No. of Specimen	Locality	Species	Remarks
1	Dongonab, Red Sea	*L. roissyana*	Corallum (11 × 11 × 9 cm.) incrusting. Most corallites simulate *B. ehrenbergana* in possessing distinct columella with short rods and rough septa. Pl. 17, fig. 4.
2	,,	,,	Corallum (16 × 11 × 8 cm.) approaches *L. ehrenbergana*—columella half to two-thirds width of calyx with short rods, septa somewhat thicker and rough. Pl. 19, fig. 2.
3	,,	,,	Corallum (13 × 13 × 9 cm.) has varied towards *L. solida*—some corallites round, short paliform lobes from some septa meeting columella. Giant corallites with about 19 septa meeting columella.
4	,,	,,	Corallum (10 × 9 × 7 cm.) with a few giant corallites, 19—22 septa meeting columella.
5	Salomon	*L. ehrenbergana*	A small mass (9·5 × 7 × 5 cm.) with humps completely covered with corallites, perhaps dropped off from a large specimen. Corallites smaller and shallower, and quinaries have not appeared. Pl. 19, fig. 4.
6	Rotuma	,,	Corallum (15 × 7 × 7 cm.) incrusting with two humps on one of which corallites large with diameters 5·6 × 5 mm., sometimes much compressed laterally, 6 × 3 mm., about 15 septa meeting columella, up to 6 quinaries. In the valley corallites small about 2 mm. in diameter with only 12 septa meeting columella, quaternaries about 10; among these a giant-corallite 4 × 3·6 mm. with 20 septa meeting columella. Pl. 19, fig. 3.
7	Funafuti	,,	Corallum (15·5 × 10·5 × 5 cm.) flat with even surface—shows same extent of variation as in no. 6: in one half corallites large with about 6 quinaries, in the other small with up to 10 quaternaries.
8	Dongonab, Red Sea	,,	Corallum incrusting on a large mass 27 × 21 × 13 cm. with humps, showing considerable variation. Corallites round, oval, polygonal, much compressed laterally or distorted. Walls up to 1·5 mm. in thickness, inter-corallite furrows present or absent. Calices from 2 mm. wide in depressions to 8 × 3·5 mm. on eminences, depth up to 3·5 mm. Septa 3—5 orders, quinaries up to 13, 12—17 meeting columella, the latter well developed with rods or indistinct. In one region near edge corallites shallow, small, wide apart and without furrows. Pl. 18, figs. 2 and 7.
9	Hulule, Maldives	,,	Corallum (14 × 11 × 8 cm.) incrusting with humps—corallites usually round or oval slightly projecting to 1 mm., in valleys crowded together and smaller. Pl. 17, fig. 6; Pl. 34, fig. 8.
10	,,	*L. solida*	Specimen small (9 × 6 × 3 cm.) approaching *L. roissyana*—corallites polygonal, large, 4·6 × 3·6 mm. Pl. 17, fig. 9.
11	Salomon	,,	Corallum 11 × 8 × 5 cm.; septa meeting columella equally thin; pali and columella not well developed. A case of fusion of two corallites—one giant-corallite with 21 septa meeting columella. Pl. 18, fig. 3.
12	,,	,,	Corallum 11 × 4·5 × 4·5 cm.—corallites approaching *L. ehrenbergana* polygonal, projecting less ·5 mm., pali not distinct but columellar rods. Pl. 18, fig. 6.
13	Hulule, Maldives	,,	Corallum 8·5 × 6 × 2 cm. Pl. 17, fig. 8.
14	,,	,,	Corallum incrusting, corallites level or projecting about ·5 mm., primary septa much thicker than secondaries, usually only the former meeting the columella. Short rods on columella. A giant-corallite 4·5 × 3 mm. with 44 septa, of which 15 meeting columella. Pl. 18, fig. 5.
15	Dongonab, Red Sea	*L. roissyana*	Corallum 12 × 10 × 9 cm. Corallites in one edge almost circular and 1 mm. apart, in another edge circular and projecting to 1 mm. as in *L. solida*. Similar to Klunzinger's figured examples of *L. bottai* and *L. inæqualis*. Pl. 19, fig. 5.

Klunzinger's figured type of this species measures 16 × 12 × 8 cm. Its distinguishing characters are as follows: (1) septa in four orders but the fourth incomplete, the maximum numbers of quaternaries counted being ten; (2) six to ten septa meeting the columella; (3) the remaining septa very narrow; (4) columella quite rudimentary. In general appearance the specimen resembles *L. roissyana*, but its real position in the genus cannot be settled till its polyps are examined.

The single specimen from Hulule which Gardiner has referred to *L. immersa* is identical with Klunzinger's example.

GENUS *DIPLOASTREA*, NDU.GEN.

1816. *Astrea* (pars), Lamarck, Hist. Anim. sans vert., ii, p. 257.
1850. *Astrea* (pars), Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 97.
1857. *Heliastræa* (pars), Milne Edwards and Haime, Hist. Nat. Corall., p. 456.
1904. *Orbicella* (pars), Gardiner, Fauna Geogr. Maldives and Laccadives, ii, p. 774.

This genus has been created for *Orbicella minikoiensis*, Gardiner. Its characters are as follows:

Corallum. Incrusting or massive. Corallites circular not projecting. Walls fused and perforate, hence peritheca almost absent. Calices shallow. Septa in not less than two orders, the first two entocœlic, each consisting of twelve septa, exsert, much thickened towards their outer ends. Columella formed of twisted trabeculæ from septal margins. Calicular dissepiments oblique.

Polyps. Close together with narrow edge-zones, no cœnosarc. Mesenteries in not less than two cycles, each of twelve couples, usually directly continuous from polyp to polyp, primaries meeting stomodæum; all with filaments. Mesoglæa thick. Tentacles corresponding in number and position with entocœles and exocœles. Stomodæum short, laterally compressed with two directive grooves. Multiplication by budding.

Remarks. Owing to the presence of two directive couples of mesenteries *O. minikoiensis* has to be separated from the old genus *Orbicella* (Group II) and placed in Group I. But it differs from all other described genera of this sub-family in possessing, in its adult polyps, double the usual number of couples of primary and secondary mesenteries, viz. 12 in each cycle, and a highly thickened mesenterial mesoglæa, the mesenteries in consequence presenting an unique appearance in transverse section. The perforate nature of the corallite-walls indicates a probable variation of *Diploastrea* to the *Perforata*, but the perforations are larger and fewer than in the latter group and are irregular.

Distribution. Red Sea, Indian and Pacific Oceans.

1. *Diploastrea heliopora* (Lamarck) (Pl. **20**, figs. 7 and 8; **34**, fig. 9).

1816. *Astrea heliopora*, Lamarck, Hist. Anim. sans vert., ii, p. 265; 2e édit., p. 415.
1824. *Astrea heliopora*, Lamouroux, Encycl., Zooph., p. 128.
1848. *Astrea heliopora*, Milne Edwards, Grande édit. Règne Anim. Cuvier, Zooph., pl. 84 ter, figs. 1, 1*a* and *b*.
1850. *Astrea heliopora*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 99.
1857. *Heliastræa heliopora*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 459.
1904. *Orbicella minikoiensis*, Gardiner, Fauna Geogr. Maldives and Laccadives, ii, p. 774, pl. 63, fig. 35.
1907. *Orbicella minikoiensis*, Vaughan, Proc. U.S. Nat. Mus., xxxii, p. 252.

Corallum. Incrusting, tending to be massive, somewhat convex, not rising into hillocks. Corallites more or less circular in outline, not projecting. Walls up to 3 mm. thick, somewhat perforate, neighbouring ones fused with a shallow groove in the middle. Calices from 8—10 mm. in diameter, shallow, varying from flat to 2 mm. in depth.

Septa in two orders, both entocœlic, each consisting of 12—sometimes a few exocœlic tertiaries up to 7 (in one corallite 14)—highly exsert about 2 mm. ; sides tuberculated, often perforated ; edges with 4—8 bluntly pointed teeth, the longest representing the most exsert part of septum ; outer half or two-thirds of septa much thicker (up to 1 mm.) swollen in thecæ, thinning out within calices ; primaries usually thicker and somewhat more exsert than secondaries, both meeting columella ; tertiaries when present thinner, of varying width, 1—3 sometimes reaching columella, edges usually curving towards and fusing with sides of adjacent secondaries. Exsert ends of septa arched, with bluntly pointed teeth. Costæ, also with blunt teeth, either continuous from corallite to corallite or alternating, when continuous with a distinct notch over inter-corallite furrows; in overhanging edges of corallum, thinner than exsert ends of septa, sometimes very thin; exocœlic costæ present alternating with the main ones. Columella circular in outline, thick, from a third to half the diameter of calices, from upper surface appearing fasciculated, formed of twisted trabeculæ from septal margins, in some corallites terminating in upright rods. Calicular dissepiments sloping into columella at an angle of 35°, about 1 mm. apart.

The perforate walls, shallow calices, stout twisted columella and thick exsert toothed septa give the corallum an unique appearance. Smaller corallites formed by budding are intercalated between the larger ones. Corallites at the margin of the corallum have thinner septa which pass over its edge as costæ and loosely trabecular columellæ.

In the sections of the corallum the septa appear to be continuous from corallite to corallite, but this continuity is really secondary, as in the young corallites the costal surfaces are demarcated off. The perforate wall seems to be formed by the perithecal deposit uniting here and there the peripheral thickened septal parts. The peritheca is without any dark centres and hence appears distinct from the septal "trabeculæ."

Polyps. Large, almost circular in outline, about 8 mm. in height, closely aggregated with narrow edge-zones and no cœnosarc. Oral-disc much narrowed, about 2 mm. wide in the retracted condition. Mesenteries constituting two complete cycles, each of 12 couples. Outer skeletal attachments of some of the mesenteries of neighbouring polyps tending to unite, hence appearing to be continuous from polyp to polyp. The mesenteries with filaments containing nematocysts II and III in their coils, primaries meeting stomodæum*. Tentacles as in genus ; well developed terminal batteries present with closely packed nematocysts I and II *b* interspersed ; also sub-terminal batteries (number doubtful). Stomodæum laterally compressed.

Remarks. A. *Polyps.* The histology of the polyps could only be imperfectly studied owing to partial maceration of their tissues. The ectoderm of oral-disc is thick with narrow diverging tracts containing nuclei in the centre ; granular and mucous vacuoles

* It is possible that the presence of twelve couples of primary mesenteries in the adult polyps may be due to six couples of secondaries having grown and met the stomodæum; if so the twelve secondary couples in that stage would be tertiaries, but this can be settled only by examining young polyps which were not available.

present but nematocysts rare. The calicoblast is thickened near skeletal attachments of mesenteries, in transverse section resembling ectoderm of oral-disc. In some of the terminal batteries numerous long narrow bodies, homogeneously stained pink in eosin, are seen (as in *Favia doreyensis*, Ed. and H.) which may probably be immature stages in the development of nematocysts II *b*. The mesoglæa is thick. The entocœlic pleats extend over the outer halves of primary mesenteries in the stomodæal region of polyps, being narrow, thick and unconstricted at their bases, below stomodæum becoming broader and extending over the greater part of the width of mesenteries, some of them being subdivided. Mesenterial mesoglæa is stouter in pleatal region, thickening again towards stomodæum, the connecting sheet being narrow and thin. Groups of small bodies stained dark in iron hæmatoxylin are present in the outer mesenterial mesoglæa, probably spores of algæ. The endoderm of oral-disc is not thicker than the ectoderm over it and contains numerous algæ; the mesenterial endoderm is thickened on either side of the inner stouter region of mesoglæa.

Polyps examined, three from a specimen from Minikoi.

B. *Corallum.* In Lamarck's collection in the Paris Museum are two small specimens (8×8×3·5 cm. and 8·5×5·5×2·5 cm.) from "mers Australes" named *Heliastræa heliopora* by Milne Edwards and Haime which were doubtless Lamarck's originals of *Astrea heliopora* (Pl. **20**, fig. 8). These are similar to Gardiner's examples of *Orbicella minikoiensis*, but the calices are somewhat smaller with an average diameter of about 7 mm., and a cycle of thin costæ are present regularly alternating with the main ones, those of neighbouring corallites usually meeting in notches, their corresponding septa being quite rudimentary or absent.

Resembling Lamarck's examples are two undescribed specimens in the Berlin Museum, which Dr Weltner tells me were collected by Dr Dahl in 1897 from Ralum (New Pommern). One of these is large measuring 30×21 cm., the other a hump, 12×11 cm. in size; the secondary septa in their corallites are much thinner than the primaries, some of them not reaching the columella; an alternating cycle of thin costæ are present and the columella is about one-third the width of the calices.

Vaughan records a single specimen from French Somaliland, East Africa, which he says is identical with *Orbicella minikoiensis*, Gard.

Localities. Minikoi (4). Also from Australia (Lamarck), French Somaliland (Vaughan), New Britain (Dahl). Not known from the Red Sea.

ADDENDA. SOME TYPE SPECIMENS.

The following species are not represented in my collections, but I have examined examples. From a study of their septal arrangement there is hardly any doubt that they possess both the bilateral and hexameral symmetries, but it is not possible to determine the genera to which they belong without examining their polyps.

1. *Stephanocœnia intersepta* (Esper); Ed. and H., Ann. Sci. Nat., 3e sér., x., Pl. 7, fig. 1, 1 *a* and *b*, and Corall. ii., p. 265.

   In Milne Edwards and Haime's three examples of this species the corallites are small

and polygonal, the calices being 2—2·5 mm. in diameter. In every corallite about 12 septa meet the columella, each usually with a conspicuous paliform lobe; six (secondary septa) of these septa are somewhat thinner than and alternate with the others (primary septa); an alternating cycle of twelve narrower septa (tertiaries) is present. The columellæ are unique in being quite solid rods—it would be interesting to see if the columella arises as such from the basal plate—which are either circular in outline or somewhat laterally compressed and rough at their upper ends. New corallites appear to arise by true budding.

There are two more examples of this species in the Paris Museum, one of which is from St Thomas (Duchassaing). The types of Milne Edwards and Haime's two remaining recent species of *Stephanocœnia*, viz. *S. michelini* and *S. dendroidea*, are missing.

Esper's figures (p. 99, Pl. 79) of *Madrepora intersepta* are not adequate for satisfactory comparison with Milne Edwards and Haime's types.

When polyps are examined *Stephanocœnia* may, in all probability, prove to be a good genus. Its nearest ally appears to be *Leptastrea*.

2. *Heliastræa cavernosa* (Esper); Ed. and H., Corall. ii., p. 463.

Heliastræa gigas, Ed. and H., Corall. ii., p. 458.

In the Paris Museum are four large specimens and two small ones from "mers d'Amerique," referred by Milne Edwards and Haime to *Heliastræa cavernosa*. In these the corallites are circular, projecting more and further apart than in *Heliastræa conferata*, Ed. and H. (hence the costæ are better seen), their walls increasing in thickness from the corallite-margins towards the peritheca. The calices are 7 or 8 mm. in diameter; usually 24 septa meet the columella in every corallite; alternating with these is a cycle of narrower septa. The columellæ are well developed, being $\frac{1}{3}$—$\frac{1}{2}$ the width of the calices and formed of septal trabeculæ. The costæ are alternately large and small, corresponding to the two septal cycles, those of the neighbouring corallites usually meeting in notches. The peritheca is highly vesicular and tends to break down; thus the corallum approaches the conditions in *Diploastrea heliopora*; when the peritheca is entirely removed, the corallites appear as long cylinders.

There are three more specimens with the same name, but they are quite small and much rubbed.

There is no doubt that Milne Edwards and Haime's examples are identical with Esper's figure of *Madrepora cavernosa* (p. 18, Pl. 37). They have also a certain resemblance to one of my specimens (no. 13) of *Echinopora gemmacea* (Lam.).

The only example of *Heliastræa gigas* in the Paris Museum has only two sectioned corallites, resembling those of *Heliastræa cavernosa*.

3. *Explanaria argus*, Ehrb., Corall. ii., p. 83 [non *Astrea argus*, Lam., which is *Heliastræa cavernosa* (Esper)].

Heliastræa conferata, Ed. and H., Corall. ii., p. 460.
Heliastræa lamarckana, Ed. and H., Corall. ii., p. 465.

Of Milne Edwards and Haime's examples of *Heliastræa conferata* (locality unknown)

one is small and much worn, while the other is larger ($14 \times 10 \times 7$ cm.) and in better condition. In this the corallites are slightly projecting and are separated from one another by polygonal furrows; about 24 septa (edges toothed but no paliform lobes) meet the columella in the corallites, which are all equally thin in the calices, but somewhat thickened in the walls; alternating with these is a cycle of narrower septa. The columellæ are about one-third the width of the calices and formed of twisted septal trabeculæ rising into short upright rods. The costæ of all the septa are similar to one another, those of the neighbouring corallites usually meeting in the inter-corallite furrows.

The two examples of *Heliastræa lamarckana* in the Paris Museum are small and of little use.

Ehrenberg's two examples of *Explanaria argus* are small and defaced; they may probably constitute a single species along with Milne Edwards and Haime's types mentioned above.

This species differs from *Heliastræa cavernosa* in the corallites being smaller, closer together, and somewhat less projecting.

In the Paris Museum there are three more specimens named *Heliastræa conferata*, which appear to belong to a different species: a large one from Guadeloupe with smaller corallites than in *Heliastræa conferata* and fewer septa meeting the columellæ, and two small ones from St Thomas (Duchassaing) in which the columellæ are much thicker.

4. *Madrepora annularis*, Ell. and Sol., Zooph., p. 169, Pl. 53, figs. 1 and 2.
   Astrea annularis, Lam., Hist. Anim., p. 259 (non var. 2 which is *Favia acropora*).
   Explanaria annularis, Ehrb., Corall. p. 84.
   ? *Orbicella annularis*, Dana, Zooph., p. 214, Pl. 10, fig. 6.
   Heliastræa annularis, Ed. and H., Corall. ii., p. 473.
   Madrepora stellulata, Ell. and Sol., Zooph., p. 165, Pl. 53, figs. 3 and 4.
   ? *Orbicella stellulata*, Dana, Zooph., p. 215, Pl. 10, fig. 7.
   Heliastræa stellulata, Ed. and H., Corall. ii., p. 473.
   ? *Plesiastræa urvillei*, Ed. and H., Ann. Sci. Nat., 3e sér., x., Pl. 9, fig. 2, and Corall. ii., p. 490.

In Lamarck's type of *Astrea annularis* (later Milne Edwards and Haime's type of *Heliastræa annularis*) the corallites are circular and slightly projecting, the calices being 2—2·5 mm. in diameter and shallow. In every corallite about 12 precisely similar septa meet the columella; alternating with these is a cycle of 12 narrower septa. A pali-crown is absent. The columella is spongy. The costæ are thick with transversely extending granulations.

In addition there are two much larger specimens in Duchassaing's collection (1870), one from Antilles and the other from St Thomas, and a third from Antilles (collected by Schramm, 1869). The remaining three examples in the Paris Museum from "mers d'Indes," "mers d'Amerique," and "Australie" respectively are small and rubbed.

Ellis and Solander's type of *Madrepora annularis* in the Glasgow Museum is much smoothed down, but is no doubt identical with the Paris specimens mentioned above.

In Milne Edwards and Haime's type ($5 \times 5 \times 5$ cm.) of *Heliastræa stellulata* from West Indies, the corallites are slightly projecting and are separated by polygonal furrows, the calices oval or circular and about 2 mm. in diameter; the septa are similar in nature and number to those of *Heliastræa annularis*; the corallum also shows clear signs of budding.

Milne Edwards and Haime's examples (5 small ones) of *Plesiastræa urvillei* from Australia come near the above specimens, but it is doubtful if they belong to the same species.

According to Duerden (**32**, p. 563) two directive couples of mesenteries are present in the polyps of *Orbicella annularis*.

5. ? *Madrepora pleiades*, Ell. and Sol., Zooph., p. 169, Pl. 53, figs. 7 and 8.

I have examined a somewhat defaced specimen in the Glasgow Museum, which, though not identical with Ellis and Solander's fig. 7, closely resembles it. Its corallites are small and circular in outline, the calices being 2—2·5 mm. in diameter. Twelve septa meet the columella in each corallite; alternating with these is a cycle of narrower septa which curve towards and fuse with the sides of the former in pairs.

Without polyps it is not possible to determine the genus to which this specimen belongs. It appears to be more related to *Cyphastrea* than to any other existing genus.

GROUP II.

GENUS *FAVIA* (OKEN).

1801. *Astrea*, sec. I, Lamarck, Syst. Anim. sans vert., p. 371.
1815. *Favia*, Oken, Lehrb. Naturg., i, p. 67.
1816. *Astrea* (pars), Lamarck, Syst. Anim. sans vert., ii, p. 257.
1830. *Tubastrea* (pars), Blainville, Dic. Sci. Nat., lx, p. 334.
1830. *Dipsastrea* (pars), Blainville, Dic. Sci. Nat., lx, p. 338.
1834. *Favia* (pars), Ehrenberg, Corall. roth. Meer., p. 93.
1834. *Astræa* (pars), Ehrenberg, Corall. roth. Meer., p. 95.
1846. *Orbicella*, subgenus I of *Astræa* (pars), Dana, Expl. exp. Zooph., p. 206.
1846. *Fissicella*, subgenus III of *Astræa* (pars), Dana, Expl. exp. Zooph., p. 220.
1848. *Astrea* (pars), Milne Edwards and Haime, Compt. rend. l'Acad. Sci., xxvii, p. 494.
1848. *Plesiastrea* (pars), Milne Edwards and Haime, Compt. rend. l'Acad. Sci., xxvii, p. 494.
1848. *Phymastrea*, Milne Edwards and Haime, Compt. rend. l'Acad. Sci., xxvii, p. 494.
1848. *Parastrea*, Milne Edwards and Haime, Compt. rend. l'Acad. Sci., xxvii, p. 495.
1848. *Oulastrea*, Milne Edwards and Haine, Compt. rend. l'Acad. Sci., xxvii, p. 495.
1848. *Acanthastrea*, Milne Edwards and Haime, Compt. rend. l'Acad. Sci., xxvii, p. 495.
1848. *Prionastrea*, Milne Edwards and Haine, Compt. rend. l'Acad. Sci., xxvii, p. 495.
1857. *Favia*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 426.
1857. *Goniastræa* (pars), Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 444.
1857. *Heliastræa* (pars), Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 456.
1857. *Ulastræa*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 488.
1857. *Plesiastræa* (pars), Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 489.
1857. *Phymastræa*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 499.
1857. *Acanthastræa*. Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 501.
1857. *Prionastræa* (pars), Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 513.

1879. *Favia*, Klunzinger, Korall. Roth. Meer., iii, p. 25.
1879. *Goniastræa* (pars), Klunzinger, Korall. Roth. Meer., iii, p. 32.
1879. *Prionastræa*, Klunzinger, Korall. Roth. Meer., iii, p. 36.
1879. *Acanthastræa*, Klunzinger, Korall. Roth. Meer., iii, p. 42.
1879. *Orbicella* (pars), Klunzinger, Korall. Roth. Meer., iii, p. 47.
1884. *Favia*, Duncan, Journ. Linn. Soc. London, Zool., xviii, p. 100.
1884. *Heliastræa* (including subgenus *Ulastræa*), Duncan, Journ. Linn. Soc. London, Zool., xviii, p. 104.
1884. *Phymastræa*, Duncan, Journ. Linn. Soc. London, Zool., xviii, p. 106.
1884. *Plesiastræa*, Duncan, Journ. Linn. Soc. London, Zool., xviii, p. 107.
1884. *Acanthastræa*, Duncan, Journ. Linn. Soc. London, Zool., xviii, p. 119.
1884. *Prionastræa*, Duncan, Journ. Linn. Soc. London, Zool., xviii, p. 123.
1899. *Astræa*, Gardiner, Proc. Zool. Soc. London, p. 747.
1899. *Orbicella* (pars), Gardiner, Proc. Zool. Soc. London, p. 751.
1899. *Prionastræa*, Gardiner, Proc. Zool. Soc. London, p. 757.
1900. *Favia*, Vaughan, Monogr. U.S. Geol. Surv., xxxix, p. 154.
1904. *Favia*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 766.
1904. *Orbicella* (pars), Gardiner, Fauna Geogr. Maldives and Laccadives, p. 774.
1904. *Stephanocœnia*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 784.
1904. *Acanthastræa*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 784.
1904. *Prionastræa* (pars), Gardiner, Fauna Geogr. Maldives and Laccadives, p. 785.
1906. *Favia*, Marenzeller, Exp. "Pola," Rot. Meer., Riffkorall., Zool. Ergeb. Wien, xxvi, p. 56.
1906. *Orbicella* (pars), Marenzeller, Exp. "Pola," Rot. Meer., Riffkorall., Zool. Ergeb. Wien, xxvi, p. 60.

Corallum. Massive or incrusting, varying considerably in form of growth. Corallites polygonal, oval, circular or distorted, usually separated by perithecal regions of varying thickness, level or projecting with distinct rims, sometimes with walls completely fused as in *Goniastrea*. Calices varying much in size, from 2 to 20 mm. or more in diameter. Septa without any cyclical arrangement, varying considerably in number and nature in the different species. Costæ present when walls project, those of neighbouring corallites usually meeting along the middle of the intervening perithecal regions. Columella formed of septal trabeculæ, a rudimentary to well developed compact structure.

Polyps. Varying in shape and size as the corallites. Mesenteries without directive couples, and without regular alternation, principal couples 6—12, varying only slightly in number in each species. Subsidiary couples from same number as principal couples to more than twice as many, varying much in number in the same species, also in relative height and width, this variation due to continued addition of new mesenteries in the course of polyp-growth, some of the later ones being so short as not to extend below the stomodæal regions of polyps. Stomodæum laterally compressed, no directive grooves, its ridges varying considerably in width and thickness. Every tentacle with a large terminal battery and from three to eight much smaller sub-terminal ones. Entocœlic pleats varying much in size, shape and distribution. All types of nematocysts excepting II *c* and III *b* present. Stomodæal endoderm very thin. Ova occurring in both principal and subsidiary mesenteries.

Multiplication as a rule by fission, sometimes aided by budding.

Remarks. I agree with Vaughan that the name *Favia* as originally employed by Oken should be retained for section I of Lamarck's *Astrea*, typified by *Madrepora rotulosa*, Ell. and Sol.

This genus has a wide range of variation—as is seen from a comparison of two

extreme species like *F. acropora* and *F. hirsuta*. Indeed, it is possible that a comparative study of the polyps of the three known species with the largest corallites, viz. *F. hirsuta*, *F. vasta*, and *F. favosa*, may afford sufficient data for grouping them under a separate genus. Till then, I consider the present arrangement as the most satisfactory.

A study of polyp-morphology has revealed how unnatural the genera *Heliastræa* and *Orbicella* are as constituted respectively by Milne Edwards and Haime and Gardiner. Of the species of *Heliastræa*, Ed. and H., not represented in my collection, *H. conferata*, *H. cavernosa*, *H. lamarckana*, and *H. stellulata*, would, in all probability, prove to have bilateral and radial symmetries. *H. radiata* and *H. quadrangularis* are represented, in the Paris Museum, each by a small completely worn-out specimen useless for specific determination and *H. gigas* by an example consisting of only two sectioned corallites. Milne Edwards and Haime constituted a new genus and species,—*Ulastræa crispata*, for two small bits of coralla from the Indian Ocean, one incrusting on a Gasteropod shell and the other on a piece of stone; there is little doubt that these two examples belong to *Favia* but they are too small for determination. These authors also created the genus *Phymastrea* on the strength of a single skeletal character, viz. the presence of definite inter-corallite grooves; a character shared by many species of *Favia*.

Distribution. Indian and Pacific Oceans. Jurassic to Recent (Eastman after Zittel).

1. *Favia favus* (Forskål). (Pl. **9**, fig. 2; **20**, figs. 1—6; **21**, figs. 1—8; **22**, figs. 1—5; **32**, fig. 1; **35**, figs. 1 and 2.)

1775. *Madrepora favus* (pars), Forskål, Descr. Anim. in Itin. Orient., p. 132.
1775. *Madrepora cavernosa*, Forskål, Descr. Anim. in Itin. Orient., p. 132 (non *Madrepora cavernosa*, Esper or Klunzinger).
1786. *Madrepora denticulata*, Ellis and Solander, Nat. Hist. Zooph., p. 166, pl. 49, fig. 1 (non *Favia denticulata*, Gardiner).
1816. *Astrea denticulata*, Lamarck, Hist. Anim. sans vert., ii, p. 263; 2e édit., p. 413.
1830. *Dipsastrea denticulata*, Blainville, Dict. Sci. Nat., lx, p. 338; Manuel d'Actin. p. 373.
1833. *Astrea ananas*, Quoy and Gaimard, Voy. l'Astrol., Zooph., p. 207, pl. 16, figs. 6 and 7 (non *Astrea ananas*, Lamarck).
1834. *Favia versipora*, Ehrenberg, Corall. roth. Meer., p. 93 (non *Astrea versipora*, Lamarck).
1834. *Favia denticulata*, Ehrenberg, Corall. roth. Meer., p. 94.
? 1834. *Astræa deformis*, Ehrenberg, Corall. roth. Meer., p. 96 (non *Astrea deformis*, Lamarck).
1850. *Prionastrea rousseaui* (pars), Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 131.
? 1850. *Prionastrea seychellensis*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 132.
1850. *Parastrea denticulata*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 167.
1850. *Parastrea affinis*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 167 (non *Favia affinis*, Gardiner).
1850. *Parastrea deformata*, Milne, Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 168.
1850. *Parastrea rousseaui*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 168.
1850. *Parastrea amicorum*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., x, pl. 9, fig. 9, and xii, p. 171.
1850. *Parastrea savignyi*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 173.
1857. *Favia denticulata*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 428.
? 1857. *Favia affinis*, Milne Edwards and Haime, Hist. Nat. Corall., ii, 429.
1857. *Favia rousseaui*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 429.
1857. *Favia amicorum*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 431.
1857. *Favia Jacquinoti*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 433 = *Parastrea jacquinoti*, Valenciennes, Mss., Catal. Mus. Paris.

1857. *Favia geoffroyi*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 433 = *Parastrea geoffroyi*, Valenciennes, Mss., Catal. Mus. Paris.
1857. *Favia deformata*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 434.
1857. *Favia savignyi*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 437.
1857. *Favia aspera*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 438 = *Parastrea aspera*, Valenciennes, Mss., Catal. Mus. Paris.
? 1857. *Prionastræa seychellensis*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 517.
1857. *Prionastræa halicora* (pars), Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 517.
1879. *Favia denticulata*, Klunzinger, Korall. Roth. Meer., ii, p. 27.
1879. *Favia clouei*, Klunzinger, Korall. Roth. Meer., iii, p. 29 (non *Favia clouei*, Milne Edwards and Haime).
1879. *Favia ehrenbergi*, Klunzinger, Korall. Roth. Meer., iii, p. 29, pl. 3, fig. 5 (var. *laticollis*), ? fig. 7 (gewöhnlichste Form), fig. 8 (var. *sulcata*), and pl. 9, figs. 1_a and 1_b.
? 1879. *Goniastræa seychellensis*, Klunzinger, Korall. Roth. Meer., iii, p. 33, pl. 4, fig. 3.
1899. *Astræa puteolina*, Gardiner, Proc. Zool. Soc. London, p. 749.
? 1904. *Favia versipora*, Gardiner, Fauna Geogr. Maldive and Laccadive Archipel., ii, p. 766.
1904. *Prionastræa spinosa*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 785.
1904. *Prionastræa magnistellata*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 788, pl. 64, figs. 40 and 41.
1904. *Prionastræa suvadivæ*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 789.
1906. *Favia savignyi*, Marenzeller, Exp. "Pola," Rot. Meer, Riffkorall., Zool. Ergeb. Wien, xxvi, p. 56, pl. 25, figs. 84—89, and pl. 24, fig. 79 (= *Madrepora cavernosa*, Forskål).
1907. *Favia savignyi*, Vaughan, Proc. U.S. Nat. Mus. Washington, xxxii, p. 256.

Corallum. Massive, often rounded, sometimes incrusting. Corallites polygonal, often distorted, sometimes oval, slightly projecting, with distinct rims, up to 5 mm. apart, the intervening perithecal regions being flat and vesicular. Calices varying much in size, up to 20 × 12 mm., average 12 × 10 mm., somewhat decreasing in width from calicular margins to bases, by depth up to 14 mm., average 8 mm.

Septa usually thin, sometimes thickened, vertical or slightly sloping with toothed edges, rough sides, 60—70 in number in the largest corallites, 30—45 in the average sized ones; up to 25 septa meeting columella (usually about 18), about 1 or 1·25 mm. exsert, with up to 14 teeth, usually becoming elongated from calicular margin to columella. A definite pali-crown absent. Some of the broader subsidiary septa usually curving towards and fusing with sides of principals. Exsert ends of septa arched or flat, finely toothed, meeting in notches or not actually meeting, giving an appearance of furrows over the perithecal regions, sometimes directly continuous from corallite to corallite. Columella varying in degree of development, from loosely inter-crossing septal teeth to twisted trabeculæ.

Multiplication by fission, more often sub-equal than unequal.

The skeleton is highly variable in this species but two main types are to be recognized: (1) characterised by light corallum, somewhat narrow perithecal regions, large and deep calices, numerous thin septa, the principals with their lower halves or one-thirds somewhat oblique, columella imperfectly formed (*e.g. Prionastræa magnistellata*, Gard., *Favia jacquinoti*, Ed. and H., *Favia geoffroyi*, Ed. and H.); (2) a thicker and rougher type with heavy corallum, broader perithecal regions, smaller and shallower calices, fewer septa but broader at the calicular margins, thicker and rougher, the principals dipping vertically to the columella or their lower parts usually entire, broader, ending

in a simulated pali-crown. Columella formed of twisted trabeculæ (*e.g. Favia ehrenbergi* var. *laticollis*, Klunz.).

In some specimens the corallite-rims are distinct, oval or circular as in the following species, *F. doreyensis*.

The specimen referred by Gardiner to a new species *P. suvadivæ* is only an abnormal skeletal variation of the present species. The much greater thickness of the perithecal regions and the somewhat filled in appearance of the calices are doubtless due to slackened growth under unfavourable conditions; as Gardiner suggests, "it was probably growing on the edge of a lagoon shoal and fell off into deeper water, the muddy bottom of which was slowly killing it." It is remarkable that other Suvadiva specimens, cp. *Cyphastrea maldivensis*, should also show the same type of modification.

Polyps. (1) Both entocœlic and exocœlic tentacles present. (2) Stomodæal ridges as thick as or thicker than broad, with sides either parallel or constricted at their bases and inner surfaces somewhat flattened. (3) About ten principal couples of mesenteries. (4) In the stomodæal region of polyp subsidiary couples of mesenteries about twice the number of principal couples. (5) In same region of polyp, entocœlic pleats narrow, unconstricted, undivided and not extending to middle of width of principal mesenteries; inner one-sixth of mesoglæa thickened with a few narrow exocœlic pleats, remaining part thin. (6) Mesenterial endoderm uniformly thin, except on each side of the inner thickened region of mesoglæa where it is swollen. (7) Convolutions of mesenteries massed together in inter-mesenteric chambers below stomodæum in the stomodæal region of polyp, a characteristic appearance in transverse section is due to convolutions of subsidiary mesenteries lying massed together as far inwards as the latter extend.

Remarks. A. *Polyps.* Two of the typical polyps have each ten principal couples of mesenteries, two of which are incomplete; the remaining polyps have from nine to twelve couples. The number of subsidiary couples varies from twelve to eighteen. The exocœlic tentacles appear longer than the entocœlic ones. The terminal tentacular battery is large and contains in its peripheral region closely packed nematocysts I, each with from forty to fifty turns of the spiral; among these are a few of type II *b* (mostly thrust out of the batteries in the sections); below the nematocysts saccular nuclei of varying size are crowded together. Sub-terminal batteries number from four to eight. A thin longitudinal layer of muscle-fibres is clearly visible on the outer surface of the tentacular mesoglæa.

The stomodæum is oval in transverse section, with diameters measuring about 2 mm. and 1·5 mm.; its ridges are closely approximated to one another, but form deep and narrow grooves between. Digestive vacuoles are frequently found in the peripheral part of each ridge; in this region nuclei, which have assumed the saccular appearance of those of the tentacular and oral-disc ectoderm, are thickly crowded together, some extending even into the central region of the ridge. Numerous nematocysts I are present in the lower half of each ridge; the development of these in such large numbers may account for the vesicular condition of the nuclei; nematocysts III are rarely met with. The mesoglæa is considerably thickened in the ridges. The ectoderm of the oral-disc is typical; along its middle saccular nuclei (oval and elongated) are aggregated in diverging tracts of

protoplasm between which mucous vacuoles are frequently present; in the lower half of the layer the protoplasm is clearer with scattered round nuclei.

Filaments are present on all the mesenteries. Nematocysts I are quite common in the straight regions of the filaments of the principal mesenteries, less frequent in those of the subsidiary mesenteries; in the coils numerous nematocysts II and III are present, the former with the dark-stained axis slightly bent and the latter with the thread partly extruded; type I is scarce. The endoderm has a slaty-blue colour, conspicuous in the mesenteries; in the oral-disc it is thinner than the overlying ectoderm; the circular layer of endodermal muscle-fibres is well seen. The tentacular endoderm is less than half the thickness of the sub-terminal batteries, with comparatively few algæ. The mesenterial endoderm is only slightly swollen behind the filaments; incomplete nematocysts II are occasionally met with in it. Algæ are comparatively rare, occurring mostly on the entocœlic side in the outer pleatal region and on the exocœlic side in the inner pleatal region. To the inner exocœlic pleats thick muscle-bands are attached which make up for the somewhat weak musculature on the entocœlic pleats. Below the stomodæal region of the polyp, the exocœlic pleats do not extend, but the entocœlic pleats cover almost the entire width of the mesenteries. One, two or three longitudinal rows of somewhat small ova were present in all the polyps, in some of the principal and subsidiary mesenteries.

Number of polyps examined, fourteen, taken from ten different specimens of varying skeletal facies, all from Dongonab, Red Sea.

B. *Corallum.* The exact position of the specimen from Minikoi, measuring $12{\cdot}5 \times 11{\cdot}5 \times 6$ cm., which Gardiner referred to *Favia versipora* (Ehrb.), is doubtful (Pl. **21**, fig. 4). As pointed out by him it comes nearest to the typical form of Klunzinger's *Favia ehrenbergi* (Pl. III, fig. 7). Its corallites are polygonal, often elongated for fission, the single calices being quite small, about 4 mm. wide and as much deep (the diameters of the longest calyx with signs of fusion into three being 10 and 3·6 mm.). The inter-calicinal walls are flat above, about 2 mm. thick. The septa are few in number, about 20, of which 10—12 meet the columella; they are thick, vertical, with rough sides and 4 or 5 bluntly-pointed horizontal teeth on their edges. The septa of adjacent corallites are usually continuous over the walls, being about ·5 mm. exsert; the exsert ends are sometimes connected along the middle of the walls by thin longitudinal ridges. The columellæ are formed of dense trabeculæ, often quite compact and $\frac{1}{4}$—$\frac{1}{3}$ the width of the calices. Fission is sub-equal. The specimen also approaches Pl. **21**, fig. 3, in appearance, but the latter has larger corallites and thicker walls.

Marenzeller has already pointed out Klunzinger's error in regarding *Madrepora favus*, Forsk. as a species of *Goniastrea*. Five of Forskål's examples of this species are at present in the Copenhagen Museum, one of which ($21 \times 17 \times 15$ cm.) comes near Milne Edwards and Haime's type of *Favia bertholleti*. The remaining four (Pl. **22**, figs. 1—4) are skeletal varieties of the present species; one of these ($11 \times 10{\cdot}5 \times 9$ cm., fig. 4) has thick perithecal regions, distorted corallites, approaching the condition in Klunzinger's type of *Favia ehrenbergi*, var. *laticollis*. *Madrepora cavernosa*, Forsk. is represented by a single specimen ($17 \times 17 \times 11{\cdot}5$ cm., Pl. **22**, fig. 5), which retains the normal charac-

teristics of the present species but is different from Klunzinger's example of *Favia cavernosa.*

Ellis and Solander's type of *Madrepora denticulata* is missing from the University Museum, Glasgow, but judging from their figure it certainly belongs here.

In the Paris Museum there are six specimens from the Red Sea which had been originally referred by Milne Edwards and Haime to *Favia denticulata*; of these four had later been assigned to *Favia savignyi*, Ed. and H., one of which (measuring 16 × 10 × 8 cm.) had been marked by Milne Edwards and Haime as their type of *Favia denticulata*; a fifth specimen (round, 11 × 11 × 8 cm., with distorted corallites) was referred to *Favia geoffroyi*, Ed. and H., while the last (also round, 9 × 8 × 5 cm.) had been erroneously referred by Klunzinger to his species, *Favia cavernosa. Favia savignyi*, Ed. and H., is represented by ten excellent examples (excluding the *denticulata* specimens above referred to) from Red Sea, one of which is in Lamarck's collection, having obviously been his type of *Astrea denticulata* (Pl. **21**, fig. 8); these show many of the skeletal variations exemplified in my collections. The single specimen (12 × 8 × 9 cm.) of *Favia amicorum*, Ed. and H., from Tongatabou also belongs here, but its corallum is much lighter, with thin perithecal regions, and fewer septa, these differences being doubtless due to conditions of growth. Two specimens (15 × 9·5 × 4 cm. and 9 × 9 × 6 cm.) with large corallites from unknown locality on which Milne Edwards and Haime had formed a new species, *Favia jacquinoti* (Pl. **21**, fig. 7), are identical with Gardiner's Minikoi example of *Prionastræa magnistellata* (fig. 40). These authors had also assigned a specimen each to *Favia geoffroyi* and *Favia deformata*, measuring respectively 10·5 × 10 × 7 cm. (Red Sea) and 10 × 10 × 8 cm. (unknown locality). *Favia aspera*, Ed. and H., is represented by five specimens from the Red Sea, the largest measuring 20 × 20 × 12 cm. Identical with the latter specimen are a large example (23 × 23 × 14 cm.) from Seychelles which Milne Edwards and Haime had made the types of *Favia rousseaui* (Pl. **21**, fig. 5), and five others referred by them to *Prionastræa halicora.* The corallites of their type (18 × 16 × 11 cm.) of *Favia affinis* have almost the same facies as that of the present species but the corallum is lighter (Pl. **21**, fig. 6).

In the Berlin Museum are five specimens assigned by Klunzinger to *Favia ehrenbergi*, Klunz.; two of these, which had been Ehrenberg's originals of *Favia versipora* (=*F. ehrenbergi*, var. *laticollis*, Klunz., fig. 8), resemble one of Forskål's examples of *Madrepora favus.* Klunzinger erroneously regarded *Favia clouei*, Ed. and H., as practically identical with his *F. ehrenbergi* var. *sulcata* (fig. 8); the last specimen (fig. 7) has smaller corallites and fewer septa, its place in the present species being doubtful. The appearance of pali-crowns in Klunzinger's type (8·5 × 7·5 × 3·5 cm.) of *Goniastræa seychellensis* is due to a ring of upturned septal teeth four or five rows above the columella. Somewhat resembling this specimen is Studer's large "Gazelle" example of *Prionastræa seychellensis* from New Ireland. Ortmann's example (11·5 × 8·5 cm.) of *Favia ehrenbergi* from Dar-es-Salaam also belongs to *F. favus.* Ehrenberg's type specimen of *Astræa deformis* (Pl. **35**, fig. 1) perhaps belongs here, but it has also some resemblance to *Favia bertholleti.*

Marenzeller has made an extensive study of *Favia savignyi*, Ed. and H., to which he

has referred 41 specimens of the "Pola" expedition, 26 from Idda, 10 from Kamaran, 2 from Manuret and Hamidije, 1 each from Massawa, Bernice and Dahab. The Idda, Bernice and Dahab specimens are heavier, thicker and rougher, belonging to var. 2 of *F. favus*, characterised by heavy coralla, many of them having the facies of Klunzinger's type of *F. ehrenbergi* var. *laticollis*, while the rest are lighter, thinner and less coarse, belonging to var. 1. No. 15954 from Kamaran resembles Milne Edwards and Haime's type of *Favia amicorum* and No. 15943 from Idda has towards its edge the facies of Ehrenberg's type of *Favia complanata*.

Localities. Red Sea (104). Chagos, Salomon (6). Seychelles (4). Maldives: Suvadiva (1 from 25 fms.); Hulule (1 from reef). Minikoi (2 from reef). Singapore (1 between reef and shore). Ceylon, Weligama (1). Funafuti, Ellice Islands (2 doubtful). A species of wide distribution, particularly common in the Red Sea. Also from Tongatabou (Milne Edwards and Haime) and Dar-es-Salaam (Ortmann).

2. *Favia doreyensis*, Milne Edwards and Haime. (Pl. **9**, figs. 1 and 3; **22**, figs. 8 and 9; **32**, figs. 2—4.)

1801. *Astrea rotulosa*, Lamarck, Syst. Anim. sans vert., p. 371 (non *Madrepora rotulosa*, Ellis and Solander).
1816. *Astrea rotulosa*, Lamarck, Hist. Anim. sans vert., ii, p. 259; 2e édit., p. 405.
1816. *Astrea ananas*, Lamarck, Hist. Anim. sans vert., ii, p. 260; 2e édit., p. 406 (non *Madrepora ananas*, Ellis and Solander).
1850. *Parastrea doreyensis*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 168.
1850. *Parastrea urvilliana*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 169.
1850. *Parastrea rotulosa*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 170.
1850. *Parastrea ananas*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, 172.
1850. *Parastrea amplior*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 172.
1857. *Favia rotulosa*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 429.
1857. *Favia urvilleana*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 432.
1857. *Favia doreyensis*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 432.
1857. *Favia ananas*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 435.
1857. *Favia amplior*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 436.
? 1889. *Goniastræa serrata*, Ortmann, Steinkorall, Süd. Ceylons, Zool. Jahrb., iv, p. 526, pl. 15, fig. 10.
1899. *Astræa okeni*, Gardiner, Proc. Zool. Soc. London, p, 749, pl. 47, fig. 2.
? 1904. *Favia cavernosa* (pars), Gardiner, Fauna Geogr. Maldives and Laccadives, p. 767, pl. 61, fig. 13 (non *Madrepora cavernosa*, Forskal and *Favia cavernosa*, Klunzinger).
1904. *Favia denticulata*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 768, pl. 61 (non *Astrea denticulata*, Lamarck or Gardiner, *Favia denticulata*, Ehrenberg, Milne Edwards and Haime, or Klunzinger).
1904. *Favia laccadivica*, Gardiner, Fauna Geogr. Maldives and Laccadives, p, 769.
1904. *Orbicella laxa*, Gardiner, Fauna Geogr. Maldives and Laccadives, p, 775, pl. 63, fig. 33 (non *Orbicella laxa*, Klunzinger).
1904. *Orbicella borradailei*, Gardiner, Fauna Geogr. Maldives and Laccadives, p, 775, pl. 63, fig. 34.

Corallum. Massive, growth-form usually rounded. Peritheca vesicular, dissepiments more or less horizontal, 1 or 1·25 mm. apart. Corallites oval, distorted or sometimes circular, projecting to about 1 mm. Walls thin or thick, 2 or 2·5 mm. apart. Calices with diameters up to 13 × 9 mm.; average 8 × 6 mm.; of equal width from calicular margins to bases, depth 2—7 mm., usually 4·6 mm.

Septa thin or thick, usually vertical, with rough sides, 20—40 in number, average 24—34. Of these 14—20 meeting columella, each with its upper half or two-thirds (edge with 2—6 teeth) narrower than its lower half or one-third and as a rule with

a paliform lobe, exsert to about 1 mm., exsert ends usually arched sometimes flat. Costæ thin and sharp or thick and flat, serrate or with transversely extending granulations, those of neighbouring corallites usually meeting in notches along the middle of the perithecal regions, sometimes alternating; an alternating cycle of smaller costæ (usually without corresponding septa) sometimes present. Columella formed of twisted septal trabeculæ, sometimes quite dense, from $\frac{1}{4}$ to $\frac{1}{2}$ width of calyx.

Multiplication by unequal or sub-equal fission.

Towards edge of specimens the corallites often project obliquely, the sides facing the edge projecting more—up to 3 mm.—than those facing the centre of corallum; the corallites are further apart (up to 4 mm.), with walls thicker, calices shallower, septa thicker and rougher, costæ flat and thick.

Gardiner's examples of *Orbicella laxa*, Klunz. and *Orbicella borradailei*, Gard. form a dense variety of the present species, characterised by obliquely projecting corallites with thick walls, well-developed paliform lobes, dense columella and a conspicuous alternating cycle of smaller costæ without corresponding septa. Some of the corallites appear to have been formed by budding. In certain regions the corallites have remained in the normal condition (see Pl. **32**, fig. 3). The examples of *Favia laccadivica*, Gard., show a somewhat crowded appearance of septa within the corallites; the cycle of smaller costæ has rudimentary septa, and the exsert ends of the septa are either directly continuous between corallites or meet in shallow notches. One of Gardiner's specimens of *Favia cavernosa* (Forsk.) has the corallites wide apart up to 7 or 10 mm. (average 3·6 or 4 mm.), not projecting; the septa and costæ are very thin, the latter directly continuous across the intervening perithecal regions and tending to be united by transverse ridges.

Polyps. (1) Both entocœlic and exocœlic tentacles present. (2) Stomodæal ridges broader than thick and somewhat constricted at their bases. (3) About eleven principal couples of mesenteries present. (4) In the stomodæal region of polyp subsidiary couples of mesenteries about twice the number of principal couples. (5) In the stomodæal region of polyp, entocœlic pleats narrow except in middle of pleatal region, where they are sometimes sub-divided, usually constricted at their bases and extending over outer halves of principal mesenteries. (6) Mesenterial endoderm vacuolated to form closely-arranged goblet-shaped spaces, swollen where entocœlic pleats are broader. (7) Convolutions of mesenteries not so abundant as to be massed together in inter-mesenteric chambers below stomodæum, scarce or even absent towards bases of polyps.

Remarks. A. *Polyps.* Of the four polyps examined three have each 11 principal couples of mesenteries (4 incomplete), while the remaining polyp has only 10 couples (6 incomplete). Subsidiary couples number 10—24, some not extending below the enterostome; the members of the same couple are frequently unequal. The convolutions of the mesenteries protrude into the edge-zone and through the oral-disc. The tentacles are often less in number than the entocœles and exocœles. The large terminal batteries consist of closely-arranged nematocysts I, each with from 35 to 40 turns of the spiral, and a few II *b*; long narrow structures, homogeneously stained pink, are seen in large number in a few of the terminal batteries as in *Galaxea fascicularis*. Four to six sub-terminal batteries are present, in which large clear oval vacuoles are conspicuous.

The stomodæum is much compressed laterally, its long diameter being about 2 mm. Owing to the breadth and thickness of the stomodæal ridges grooves are formed between them. Rod and spindle-shaped nuclei are massed together in the ridges around a somewhat granular protoplasmic region into which slender filaments pass from the mesoglæa; digestive vacuoles and a few nematocysts III and rarely I also occur. The mesoglæa is thickened, appearing concavo-convex in transverse section. Near the skeletal attachments of the mesenteries, the calicoblast is thickened and vacuolated, containing "desmocytes" at various stages of development. In the oral-disc and in the outer wall of the edge-zone the ectoderm is thick, with a columnar facies containing a row of transparent oval vacuoles; nuclei of varying shape occur in the middle of the layer, with nematocysts I and II above. Filaments are present on all the mesenteries, being rudimentary on the narrower subsidiaries; nematocysts are comparatively few in them, in their straight regions occasionally types I, II and III, and in the coils a few III. In the mesenteries the mesoglæa is thickened in the region of the wider pleats, thin in the remaining parts. Below the stomodæal region of the polyp, the entocœlic pleats extend over the greater part of the width of the mesentery.

The endoderm of the oral-disc is not so thick as the ectoderm over it, but has abundant algæ; that of the body-wall is thin above the enterostome but towards the base of the polyp becomes highly reticulated, swollen and transparent with the nuclei arranged along its periphery. The endoderm of the tentacle is thinner than the batteries, with conspicuous vacuoles giving it a somewhat lobulated appearance, and algæ are scarce. The mesenterial endoderm is only slightly thickened behind the filament; algæ are comparatively few, being more numerous in the pleatal region on the exocœlic side and in the non-pleatal region on the entocœlic side. In one of the polyps scattered nematocysts II occur in the endoderm, some of them incompletely formed. Ripe ova are present in three of the polyps in longitudinal rows of from 1 to 5 in every mesentery; immature ova occur in the endoderm surrounding the eggs.

Polyps examined, four, 1 from a specimen from Hulule whose corallum is identical with Gardiner's example of *F. denticulata*, 2 from a specimen from Hulule whose corallum resembles Gardiner's example of *Astræa okeni* and Ed. and H.'s *F. amplior*, 1 from an edge specimen from Minikoi.

B. *Corallum.* In the Paris Museum *Favia doreyensis*, Ed. and H., and *Favia urvilleana*, Ed. and H., are each represented by a single type-specimen, measuring $7{\cdot}5 \times 6 \times 5$ cm. (Pl. **22**, fig. 8) and $8 \times 5 \times 4{\cdot}5$ cm., both from Port Dorey; in the latter paliform lobes are inconspicuous. The single specimen ($10 \times 9 \times 6$ cm.) from Mers d'Amerique, the type of *Favia rotulosa*, Ed. and H., is identical with some of my specimens and was doubtless Lamarck's type of *Astrea rotulosa* (Pl. **32**, fig. 4). In Lamarck's collection is a specimen $7 \times 6 \times 2{\cdot}5$ cm. from Mers d'Amerique originally named *Astrea ananas* by Lamarck, which Milne Edwards and Haime have later made the type of *Favia ananas*. Its corallites are often irregularly compressed, one side projecting more than the other, columella and paliform lobes well developed, a cycle of smaller costæ alternating with the main ones, sometimes represented by rudimentary septa within corallites, in general appearance resembling Gardiner's examples of *Orbicella laxa* and

borradailei but calices slightly smaller and walls thinner. Similar to this example but with somewhat larger calices are two small specimens (from unknown locality) in the same collection, having the facies of Gardiner's example of *Astræa okeni* from Rotuma ; they were undoubtedly Lamarck's types of *Astrea ananas* var. *stellis amplioribus* ; on these Milne Edwards and Haime have founded their species *Favia amplior*. A large specimen ($70 \times 60 \times 35$ cm.) from Seychelles in Rousseau's collection named *Prionastræa quoyi* is identical with my types of *F. doreyensis*.

In the Berlin Museum are two specimens from Ceylon named *Goniastræa serrata*, Ortm., the larger measuring $23 \times 18 \times 17$ cm., presumably Ortmann's type; the second specimen much smaller and not properly cleaned. These do not belong to *Goniastrea* but comes near my examples of *Favia doreyensis*, their main difference consisting in the absence of paliform lobes.

In the Challenger collection is a small specimen from Fiji, which Quelch has referred to *Astræa danæ* (Ed. and H.), in every respect identical with my types of *Favia doreyensis*. A broken off fragment from Mactan Island, Philippines, which the same author has assigned to *Astræa ordinata*, Verrill, resembles Gardiner's example of *Astræa okeni* (Ed. and H.).

Localities. Maldives : Hulule (9) ; Goidu (6). Minikoi (11). Seychelles (3). Cœtivy (1). Chagos : Salomon (4) ; Coin, Peros (1); Rotuma (1). Also from American Seas (Lamarck), Port Dorey (Milne Edwards and Haime), Ceylon (Ortmann), Fiji and Mactan Island, Philippines (Quelch). Not recorded from the Red Sea.

3. *Favia hululensis*, Gardiner. (Pl. **9**, fig. 6 ; **22**, fig. 6 ; **35**, fig. 1.)

1834. *Favia rotulosa*, Ehrenberg, Corall. roth. Meer., p. 95 (non *Madrepora rotulosa*, Ellis and Solander, or *Astrea rotulosa*, Lamarck).
1899. *Astræa fragilis*, Gardiner, Proc. Zool. Soc. London, p. 748.
1904. *Favia hululensis*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 769, pl. 41, figs. 19—21.

Corallum. Massive, rounded, sometimes incrusting. Peritheca vesicular as in previous species. Corallites circular or oval, projecting from ·5—1 mm., closer together than in *F. doreyensis*. Walls thin. Calices somewhat smaller than in previous species, with average diameters $7 \times 5{\cdot}5$ mm. and of equal width from calicular margins to bases, depth 3—6 mm.

Septa thin, vertical, with toothed edges, rough sides, 20—30 in number, average 22—25. 8—12 septa meeting columella, usually 9 or 10, each with its upper half or two-thirds narrower, as a rule without paliform lobes (sometimes the lowest septal tooth tending to be paliform), exsert to about 1 mm., exsert ends arched, entire or serrate. Costæ usually thin, those of neighbouring corallites either meeting in notches or alternating. Columella rudimentary.

Multiplication by sub-equal or unequal fission.

Towards edge of specimens the corallites project obliquely as in *F. doreyensis*, up to 2 mm., and are further apart, up to 4 mm. Gardiner's specimen no. 4 (p. 770, fig. 21) is peculiar in that, crowded between the exsert septal ends of each corallite, are about 20 similar ridges without traces of septa.

In general appearance this species is like a smaller edition of *Favia doreyensis*.

Polyps. (1) Exocœlic tentacles absent. (2) Stomodæal ridges thicker than broad, their sides sloping away from apices to bases. (3) About seven principal couples of mesenteries present. (4) In the stomodæal region of polyp subsidiary couples of mesenteries about twice the number of principal couples. (5) In the same region, entocœlic pleats narrow, thick, undivided, unconstricted at their bases, directed obliquely towards stomodæum, not extending beyond outer two-thirds of width of principal mesenteries, better seen in their outer halves. (6) Mesenterial endoderm thin in pleatal region, but gradually swelling towards stomodæum. (7) Convolutions of mesenteries abundant below stomodæum to base of polyp, massed together in intermesenteric chambers.

Remarks. A. *Polyps.* These are smaller than in *F. doreyensis* but more regular in form—either circular or oval. Owing to close approximation of corallites there is little or no cœnosarc. An appearance of binary fission frequently results from the presence of two oral openings placed at equal distances from the tentacular ring. In the two polyps examined 7 principal couples of mesenteries are present, 2 of them being incomplete, and 13 subsidiary couples. The convolutions of the mesenteries are scarce in the stomodæal region. The entocœlic tentacles equal the entocœles in number. In the large bluntly pointed terminal batteries long narrow pink bodies are found as in the previous species; certain appearances suggest that these may be immature stages in the development of nematocysts II *b*. About six sub-terminal batteries are present.

The stomodæum is almost circular in transverse section, its diameter being 1·5 mm., its ridges are much less broad than in *F. doreyensis*, appearing more or less conical, with no deep grooves between, their mesoglæa only slightly thickened. Both ectoderm and endoderm are vacuolated as in the previous species, but the tentacular endoderm is thinner. Nematocysts II are present in the coils of the filaments in addition to those of types I and III. In the mesenteries the mesoglæa is usually thinner in the non-pleatal than in the pleatal region, but is thickened to a short distance from the stomodæal attachment; on this thickened region narrow entocœlic pleats are seen. Below the stomodæal region of the polyp the entocœlic pleats extend over the entire width of the principal mesenteries.

Both the polyps sectioned had eggs in every mesentery, in one or two longitudinal rows. Immature germ cells, surrounding the eggs, are better seen than in the polyps of the previous species. The proliferation of the calicoblastic ectoderm is conspicuous even towards the bases of the polyps containing cell elements similar to those of the immature ova. This appearance suggests that these polyps were in a state of reproductive activity. When all the eggs have been formed, as in the polyps of *F. doreyensis*, the calicoblast loses all signs of its proliferating activity and the follicle-cells become fewer.

In the Berlin Museum is a specimen (No. 739) measuring $14 \times 12 \times 7$ cm. referred to *Favia rotulosa* by Ehrenberg (Pl. **35,** fig. 1), resembling Gardiner's example no. 1 (p. 770, fig. 19).

Number of polyps examined, two, from a specimen from Hulule, Maldives.

Localities. Maldives: Hulule (5); Goidu (1). Ceylon (2). Rotuma (1). Funafuti

(a doubtful specimen). Cœtivy (1). Also one of Ehrenberg's specimens from the Red Sea.

4. *Favia clouei* (Valenciennes). (Pl. **10**, fig. 6; **23**, figs. 1, 2 and 5; **25**, fig. 3; **34**, fig. 1.)

1797. *Madrepora radiata*, Esper, Forts. Pflanz., p. 74, pl. 61 (non *Madrepora radiata*, Ellis and Solander).
1815. *Favia radiata*, Oken, Lehrb. Naturg., i, p. 68.
1834. *Favia uva*, Ehrenberg, Corall. roth. Meer., p. 94 (non *Madrepora uva*, Esper, which is a *Dichocœnia*).
? 1846. *Astrea (fissicella) speciosa*, Dana, Expl. exp. Zooph., p. 220, pl. 11, fig. 1.
Parastrea clouei, Valenciennes, Mss., Catal. Mus. Paris.
1849. *Parastrea radiata*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 169.
1857. *Favia okeni*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 430.
1857. *Favia clouei*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 436 (non *Favia clouei*, Klunzinger).
1879. *Favia cavernosa*, Klunzinger, Korall. Roth. Meer., ii, p. 26, pl. 3, fig. 4 (non *Madrepora cavernosa*, Forskål).
1879. *Favia tubulifera*, Klunzinger, Korall. Roth. Meer., ii, p. 28, pl. 3, fig. 6, and pl. x, fig. 2.
1899. *Astræa affinis*, Gardiner, Proc. Zool. Soc. London, p. 750 (non *Favia affinis*, Milne Edwards and Haime).
1904. *Favia cavernosa*, (pars), Gardiner, Fauna Geogr. Maldives and Laccadives, ii, p. 767, pl. 61, fig. 13.
1904. *Favia affinis*, Gardiner, Fauna Geogr. Maldives and Laccadives, ii, p. 767, pl. 62, figs. 22 and 23.

Corallum. Massive, becoming convex. Peritheca highly vesicular, vesicles on surface often like blisters, easily broken, dissepiments thin, 1—1·5 mm. apart, corallum consequently light. Corallites oval, irregularly compressed or circular, with usually distinct margins, level or projecting to 1·5 mm.; interior often appearing blistery; owing to vesicular deposition of calcareous matter; up to 7 or 10 mm. apart, average 2—4 mm. Calices 7—10 mm. in diameter, average depth 4 or 5 mm.

Septa thin in calices, often swollen in thecæ (swollen parts hollow), usually vertical, with toothed edges, spinulose sides, exsert to 1 or 1·5 mm., about 35 in number; of these up to 17 or 18 meeting columella, average 13—15, with the upper two-thirds or half much narrower than the lower one-third or half, the former with short teeth or entire edges, while the latter with 3 or 4 prominent teeth, the first two of which often vertical, simulating a pali-crown; sometimes an alternating cycle of rudimentary septa present. Columella formed of thin twisted septal trabeculæ, $\frac{1}{5}$—$\frac{1}{4}$ width of calyx, sometimes rudimentary. Costæ prominent, thin, toothed, continued over peritheca as thin ridges usually meeting those of neighbouring corallites, the perithecal costæ often tending to be united transversely by a thin heavy ridge along the middle of the perithecal regions.

Multiplication by unequal, sometimes equal, fission.

The species is characterised by the light corallum, perithecal costæ, open calices, and thin septa.

Polyps. (1) Both entocœlic and exocœlic tentacles present (the latter few in number). (2) Stomodæal ridges thicker than broad, with convex inner surfaces and sides almost perpendicular or only slightly sloping. (3) About eight principal couples of mesenteries. (4) In the stomodæal region of polyp subsidiary couples of mesenteries, about twice the number of principal couples. (5) In the same region of polyp, entocœlic pleats, somewhat narrow, unconstricted, some of them sub-divided, arising usually at right angles to the mesoglæa, sometimes sloping towards stomodæum and extending to not more than middle of principal mesenteries, usually over about one-third their width;

non-pleatal region quite thin. (6) Mesenterial endoderm swollen, more in pleatal than in non-pleatal region. (7) Convolutions of mesenteries abundant below stomodæum to base of polyps, massed in inter-mesenteric chambers.

Remarks. A. *Polyps.* Three polyps have 8 principal couples of mesenteries to each, while the number in another is only 7; of these 1—5 are incomplete. 17—20 secondary couples of mesenteries are present in the tentacular regions of the polyps, of which only 10—15 extend down to the lower end of the stomodæa. Each of the tentacles has a swollen terminal battery in which incompletely-formed nematocysts II *b* are interspersed among the closely-arranged nematocysts I, the latter with between 40 and 50 turns of the spiral; 5 or 6 sub-terminal batteries. The tentacular endoderm is vacuolated and lobulated, about the same thickness as the overlying ectoderm, with algæ massed together in the region of the terminal battery.

The stomodæum is laterally compressed, its diameters 1·5—2 mm. and ·5—1 mm. Nematocysts I are of common occurrence in the stomodæal ridges. The ectoderm of the oral-disc has numerous mucous vacuoles, the endoderm being as thick or thicker, and with closely-packed algæ. The mesenterial endoderm is vacuolated and almost transparent, the vacuoles being somewhat oval, and contains few algæ. Filaments are present on all the mesenteries; nematocysts I are present in large numbers in their straight regions, while in their coils type III are abundant (unfortunately not properly fixed); those of type II are few. The mesenterial endoderm is considerably swollen behind the filaments, up to three times the size of the latter. Below the stomodæum the endoderm of the column-wall is reticulated and quite transparent. Gonads were not present in any of the polyps examined.

The polyps of this species appear to be more nearly related to *F. hululensis* than to any other species of *Favia*.

Number of polyps examined, eight, 4, 2 and 2, all from Ceylon, also two additional polyps from a doubtful specimen from Minikoi.

B. *Corallum.* In the Paris Museum there are three large specimens (38 × 38 × 12 cm., 37 × 29 × 15 cm., 22 × 21 × 12 cm.) from Seychelles, referred by Milne Edwards and Haime to *Favia clouei*, in which the corallites are oval or irregularly compressed laterally, slightly projecting, coralla light, the perithecal dissepiments about 1·5 mm. apart and the columellæ poorly developed (Pl. **25**, fig. 2), on the whole resembling my Ceylon examples. The same authors have referred three specimens from the Red Sea to *Parastrea radiata* and later to *Favia okeni*, the largest of which measures 16 × 12 × 8 cm.; their only difference from *Favia clouei* is in the larger size of their corallites (Pl. **25**, fig. 1).

Ehrenberg's type of *Favia uva* is a large example which Klunzinger later made the type of *Favia cavernosa*. Marenzeller discovered Klunzinger's mistake in naming this specimen after Forskål's *Madrepora cavernosa* and correctly pointed out its similarity with Milne Edwards and Haime's types of *Favia okeni*. Klunzinger's two examples of *Favia tubulifera* are essentially similar to Ehrenberg's type, the only difference being that in the former the corallites are not so far apart as in the latter; my Ceylon specimens are identical with these two species of Klunzinger's. In the Berlin Museum is also a small convex specimen from Ceylon (no. 3729), referred by Ortmann to *Favia amplior*,

Ed. and H., which resembles Klunzinger's *Favia cavernosa* and belongs to the present species.

The three small specimens from Banda, referred by Quelch to *Astræa pandanus*, Dana, *Astræa doreyensis* (Ed. and H.), and *Astræa speciosa*, Dana, are identical with Klunzinger's types of *Favia tubulifera* and hence come under the present species.

Localities. Maldives, Hulule (1). Minikoi (3). Chagos: Salomon (3); Egmont (1). Ceylon: Delft and Nainitavoe (small specimens). Also from Seychelles (Milne Edwards and Haime) and from the Red Sea (Milne Edwards and Haime and Klunzinger) ? East Indies (Dana), ? loc. (Esper).

5. *Favia abdita* (Ellis and Solander). (Pl. **9**, fig. 5; **29**, figs. 1—4; **35**, fig. 2.)

1786. *Madrepora abdita*, Ellis and Solander, Nat. Hist. Zooph., p. 162, pl. 50, fig. 2.
1797. *Madrepora favosa* (pars), Esper, Forts. Pflanz., p. 34, pl. 45 A, fig. 2 (copy of Ellis).
1816. *Astrea abdita*, Lamarck, Hist. Anim. sans vert., ii, p. 265; 2e édit., p. 415.
1830. *Favastrea magnifica*, Blainville, Dict. Sci. Nat., lx, p. 340; Manuel d'actin., p. 374, pl. 54, fig. 3 (1834).
1833. *Astrea abdita*, Quoy and Gaimard, Voy. l'Astrol., Zooph., p. 205, pl. 16, figs. 4—5.
1833. *Astræa fusco-viridis*, Quoy and Gaimard, Voy. l'Astrol., Zool., iv, pl. 17, figs. 8 and 9.
1834. *Astræa pentagona*, Ehrenberg, Corall. roth. Meer., p. 96.
1834. *Astræa abdita*, Ehrenberg, Corall. roth. Meer., p. 97.
1846. *Astræa fusco-viridis*, Dana, Expl. exp. Zooph., p. 228, pl. 11, fig. 7.
? 1846. *Astræa* (*fissicella*) *magnifica*, Dana, Expl. exp. Zooph., p. 231, pl. 12, fig. 3.
1850. *Prionastrea abdita*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 128.
1850. *Prionastrea magnifica*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 129.
1850. *Prionastrea sulfurea*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 130 = *Astrea sulfurea*, Valenciennes, Mss., Catal. Mus. Paris.
? 1850. *Prionastrea quoyi*, Milne Edwards and Haime, Ann. Sci. Nat., Zool, 3e sér., xii, p. 130.
1850. *Prionastrea obtusata*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 130 = *Astrea obtusata*, Lamarck, Mss.
1850. *Prionastrea crassior*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 131 (non *Prionastræa crassior*, Gardiner).
1857. *Prionastræa abdita*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 514.
1857. *Prionastræa crassior*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 515.
1857. *Prionastrea magnifica*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 515.
1857. *Prionastræa obtusata*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 518.
1857. *Prionastræa sulfurea*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 518.
? 1857. *Prionastræa quoyi*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 519.
1877. *Prionastræa sulfurea*, Studer, Monat. Ak. Wiss. Berlin, p. 639.
1877. *Prionastræa robusta*, Studer, Monat. Ak. Wiss. Berlin, p. 640.
1879. *Prionastræa gibbosa*, Klunzinger, Korall. Roth. Meer., iii, p. 40, pl. 4, fig. 10.
1899. *Prionastræa abdita*, Gardiner, Proc. Zool. Soc. London, p. 758, pl. 47, fig. 4.
1899. *Prionastræa fusco-viridis*, Gardiner, Proc. Zool. Soc. London, p. 759, pl. 47, fig. 5.
1899. *Prionastræa purpurea*, Gardiner, Proc. Zool. Soc. London, p. 760.
1899. *Prionastræa echinata*, Gardiner, Proc. Zool. Soc. London, p. 760, pl. 47, fig. 6.
1904. *Prionastræa fusco-viridis*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 787, pl. 64, figs. 43 and 44.

Corallum. Incrusting, following irregularities on surface of attachment, frequently rising into irregular hillocks, sometimes with a corallite on top of each or more often ending in a ridge, with corallites on either side. Corallites polygonal, varying greatly in shape, often one side much higher than the other, hence with oblique calicular openings. Corallite-walls fused, ridged, the inter-calicinal partitions thus formed varying from being very thin up to 6 mm. thick, solid in section. Calices varying considerably in diameter,

widest at calicular margins, up to 20 × 12 mm., average about 11 or 12 mm., decreasing towards bases, depth up to 11 mm., usually about 8 mm., but much shallower in valleys, and near edges sometimes quite flat.

Septa varying in thickness, sloping, with toothed edges, sides smooth to rough, from 35 to 70 in number. Of these from 14 to 20 septa meeting columella, not more than 5 mm. exsert, their edges with 8 to 18 closely-arranged teeth, usually becoming elongated towards columella (up to 2 mm. high), round the latter tending to become upright. The broader subsidiary septa usually curving towards and fusing with sides of principals. An alternating cycle of rudimentary septa with entire margins present, these in adjacent corallites usually meeting the main septa at angles over the walls. Columella formed of twisted trabeculæ, 2 or 2·5 mm. in diameter.

Multiplication by very unequal fission towards the calicular margins. In the marginal region of a large corallite, one to four small corallites are frequently seen; when definite walls are formed round these, they simulate buds.

The peculiar growth-form—incrusting corallum rising into sharp-ridged irregular hillocks—fusion of corallite-walls, and the presence of small corallites near the calicular margins of the normal individuals are striking features of this species, giving the specimens an unique appearance.

Two principal types, connected by gradational forms, are to be distinguished, one in which the intercalicinal walls and septa are very thin and columella openly spongy as in most of the *abdita* specimens (Pl. **29**, fig. 1; Pl. **35**, fig. 2), the other with thicker walls and septa and columella formed of closely-twisted trabeculæ as in Gardiner's examples of *Prionastræa fusco-viridis* (Pl. **29**, figs. 3 and 4).

Polyps. (1) Exocœlic tentacles absent. (2) Stomodæal ridges usually broader than thick, constricted at their bases and with convex inner surfaces, in transverse section more or less resembling those of *F. pentagona*. (3) About nine principal couples of mesenteries. (4) In the stomodæal region of polyp subsidiary couples of mesenteries, about thrice the number of principal couples. (5) In the stomodæal region of polyp, entocœlic pleats very narrow, thick, unconstricted at their bases (in some mesenteries hardly recognisable) and restricted to outer quarter of width of principal mesenteries; mesenterial mesoglæa stouter than in *F. favus*; pleatal region thicker than non-pleatal region. (6) Mesenterial endoderm vacuolated and somewhat swollen in pleatal region and near stomodæal attachment, the vacuoles being goblet-shaped, elsewhere quite thin. (7) Convolutions of mesenteries massed together in inter-mesenteric chambers below stomodæum to base of polyp.

Remarks. A. *Polyps.* The polyps follow the very irregular shapes of the corallites. Owing to their approximation the cœnosarc is absent. About twenty-three subsidiary couples of mesenteries were counted; some of the newly-formed couples are very narrow, not extending below the stomodæal region of the polyps and without tentacles over their entocœles. The tentacular batteries resemble in shape and structure those of *F. favus*. The stomodæum is oval in transverse section with the diameters measuring about 1·25 and ·75 mm. Nematocysts I and III are occasionally present in the ridges, but the mesoglæa is not thickened in them. Filaments are present on nearly all the mesenteries, being

definitely hemispherical in transverse section ; in their straight regions nematocysts I are less numerous than in *F. favus*, while in their coils types II and III occur, the latter not in such large numbers as in *F. favus*. The endoderm stains brown when treated with iron—hæmatoxylin and eosin, specially noticeably in the mesenteries. The goblet-shaped vacuoles in the mesenterial endoderm are massed together as in *Cyphastrea serailia*. Behind the filaments the endoderm is swollen to their thickness, the filaments and their endodermal pads giving a characteristic appearance to the polyp in transverse section. Below the stomodæal region of the polyp, the entocœlic pleats are better seen and extend over the greater part of the width of the mesenteries.

In two of the polyps sectioned large ova are present in all the mesenteries in one to four longitudinal rows, with germ-cells in the endoderm surrounding them. In another polyp a group of minute dark-stained bodies of unknown nature is present in the mesoglæa of nearly every mesentery in a cavity near its skeletal attachment.

Number of polyps examined, four, 2 from a mature ♀, Hulule, Maldives, 1 from a specimen dredged off Salomon, 1 from a specimen from Ceylon.

B. *Corallum.* In the Paris Museum *Prionastræa abdita*, Ed. and H., is represented by four large specimens (three thin, the fourth somewhat thickened), probably from the Indian Ocean. A large specimen from Batavia, Indian Ocean referred by these authors to *Prionastræa magnifica* (Blain.) is similar to *P. abdita*, Ed. and H. *Prionastræa crassior*, Ed. and H., is represented by two type specimens, the larger measuring 14 × 12 cm., and *Prionastræa obtusata*, (Lam.) by a small convex one from Tongatabou, all three being of the thick type. Two small examples from Vanikoro referred by Milne Edwards and Haime to *Prionastræa sulfurea* (Valen.) and another smaller one from New Ireland to *Prionastræa quoyi*, Ed. and H., are perhaps also to be placed in this species.

Ehrenberg's example of *Astræa abdita* has dendroid hillocks with thin corallites at the top of the hillocks and thicker ones on the main stems (Pl. **35**, fig. 2). Klunzinger's original of *Prionastræa gibbosa* is only a small edition of the present species. Two worn-out specimens referred by Ehrenberg to *Astræa pentagona*, Ehrb. are quite unlike Klunzinger's example of *Prionastræa pentagona* ; they resemble the present species more than any other.

Ellis and Solander's figured type of *Madrepora abdita* (15 × 15 × 9 cm.) is in the University Museum, Glasgow ; though much damaged, its resemblance to the *abdita* specimens in Paris and Berlin is obvious.

Quelch has referred two small specimens from Kandavu, Fiji, to *Prionastræa flexuosa*, (Dana) and *Prionastræa obtusata*, Ed. and H., and two others from Amboina to *Prionastræa quoyi*, Ed. and H. ; these four resemble the thick variety of *F. abdita*. A fairly large specimen assigned to *Prionastræa robusta* (Dana) agrees with the thin type. A small fragment from Banda, referred by the same author to *Goniastræa favistella* (Dana), is identical with Klunzinger's type of *Prionastræa gibbosa*.

Localities. Maldives : Hulule (12) ; Addu (1 from edge of W. reef) ; Goidu (5). Minikoi (6). Rotuma (11). Chagos : Salomon (2) ; Egmont, (1). Singapore (2). Ceylon (small specimens). Also from Tongatabou, ? Vanikoro and ? New Ireland (Milne Edwards

and Haime), Fiji (Dana and Quelch), Amboina and Banda (Quelch), Salawatti (Studer), ? East Indies (Dana), and Red Sea (Ehrenberg and Klunzinger).

6. *Favia bertholleti* (Valenciennes). (Pl. **7**, fig. 2 ; **22**, fig. 7 ; **23**, figs. 4 and 6 ; **24**, fig. 1).

Parastrea bertholleti, Valenciennes, Mss., Catal. Mus. Paris.

1850. *Phymastrea valenciennesii*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., x, pl. 9, fig. 3, and xii, p. 124.

1850. *Prionastrea rousseaui* (pars), Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 131.

1851. *Prionastrea halicora* (pars), Milne Edwards and Haime, Pol. foss. terr. palæoz., p. 102 (non *Astræa halicora*, Ehrenberg).

1857. *Favia bertholleti*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 431.

1857. *Phymastræa valenciennesi*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 500.

1857. *Prionastræa halicora* (pars), Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 517.

? 1857. *Prionastræa australensis*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 520.

1886. *Phymastræa aspera*, Quelch, Challenger Reports, Reef Corals, Zool., vol. xvi, part xlvi, p. 105, pl. 4, figs. 1—1*b*.

Corallum. Massive, convex; corallites longer than broad, usually hexagonal in shape, close together. Calices with diameters about 12 or 13 mm. and 7 or 8 mm.

Septa usually sloping towards columella, with irregularly toothed edges (about 8 teeth), exsert to about ·5 mm. 33—40 in number (in one corallite 46 septa), 11—18 meeting columella ; the broader subsidiary septa curving towards and fusing with sides of principal septa near to where the latter meet columella. In some corallites an alternating cycle of rudimentary septa present. Columella usually formed of closely twisted septal trabeculæ, about $\frac{1}{3}$ width of calyx.

Multiplication by unequal fission.

Two principal types of corallum may be recognised in this species : (1) in which the adjacent corallite-walls are fused, the inter-calicinal walls thus formed being not more than 1 mm. in thickness, often thinner ; over these the septa are continuous in arches, the septa being thin; (2) thicker-looking in which the corallite-walls are distinct, separated on the surface by inter-corallite grooves at the margins of which the exsert ends of the septa stop ; the septa are thicker and rougher.

Polyps. (1) Both entocœlic and exocœlic tentacles present. (2) Stomodæal ridges thicker than broad, with convex inner surfaces. (3) Nine or ten principal couples of mesenteries. (4) In the stomodæal region of polyp subsidiary couples of mesenteries about twice the number of principal couples. (5) In the same region of polyp entocœlic pleats extending over almost the entire width of principal mesenteries, better developed in their outer half or one-third where the pleats are broader than in any other species of *Favia*, thin, greatly subdivided, individual ones appearing club-shaped in transverse section ; in inner one-third pleats narrower, thicker, but subdivided to a less extent ; between these two regions pleats often quite narrow or absent and the mesoglæa slightly constricted. (6) Mesenterial endoderm usually thicker in inner pleatal region, and somewhat constricted between the two regions. (7) Convolutions of mesenteries abundant to some distance below stomodæum but no blocking inter-mesenteric chambers, absent at base of polyps.

Remarks. A. *Polyps.* In three large polyps principal couples of mesenteries numbered nine, ten and eleven ; a smaller one had only seven such couples. About

twenty-one subsidiary couples were present in the tentacular region, sixteen or seventeen extended down into the stomodæal region. Numerous mucous vacuoles are present in the ectoderm of the oral-disc. The endoderm of the latter is as thick as the ectoderm, with closely packed algæ. The tentacles have swollen terminal batteries with the usual structure and four to six sub-terminal batteries; nematocysts I have about forty turns of the spiral. The tentacular endoderm is lobulated with numerous algæ but is only about half the thickness of the overlying ectoderm. The stomodæum is laterally compressed; in the lower halves of its ridges nematocysts III and I are frequently present, the former more numerous than in any other species examined. Filaments are present on all the mesenteries; in their straight regions nematocysts I are of common occurrence; in their coils are numerous nematocysts II and III. The mesenterial endoderm has comparatively few algæ; it is swollen behind the filaments to the size of the latter or even larger; into this the pleats do not extend. In transverse sections the entocœlic pleats have an unique appearance owing to their great breadth and branching nature. No gonads were present in any of the polyps.

Number of polyps examined, four, 2 from a colony from Ceylon of var. 1, and 2 from another colony from Ceylon of var. 2.

B. *Corallum.* Milne Edwards and Haime's type of *Favia bertholleti* is a large specimen (24 × 17 × 17 cm.) from Seychelles in which inter-corallite grooves are usually present (Pl. **23,** fig. 4); identical with this are some of my Ceylon specimens. Of the eight examples referred by these authors to *Prionastræa halicora*, three come under the present species. Their type of *Prionastræa australiensis* has a meandering tendency but the separate corallites resemble those of *Favia bertholleti.* The single small type of *Phymastræa valenciennesi* (an edge of a colony, measuring 5 × 4·5 × 2 cm.) perhaps belongs to the present species; it has deep inter-corallite grooves and coarse septal sides and may therefore be only an extreme case of var. 2, described above, but the principal septa have long teeth near their union with the columella.

One of Forskål's types of *Madrepora favus* (21 × 17 × 15 cm., **Pl. 22,** fig. 7) has the same facies as var. 1 of the present species. Quelch's type of *Phymastræa aspera* is a small fragment, with deep inter-corallite grooves, which in all probability belongs here.

Localities. Seychelles (2). Aldabra (2). Ceylon (5); also broken ones from Point Pedro, Nainitavoe and Delft. Also from the Red Sea (Milne Edwards and Haime and ? Forskål), ? Australia (Milne Edwards and Haime), and Banda (Quelch).

7. *Favia pentagona* (Esper). (Pl. **10,** fig. 5; **24,** figs. 2—4; **36,** fig. 4.)

1797. *Madrepora pentagona*, Esper, Forts. Pflanz., p. 23, pl. 39, figs. 1 and 2.
1834. *Astræa melicerum*, Ehrenberg, Corall. roth. Meer., p. 96.
1850. *Prionastrea gibbosissima*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 133.
1850. *Goniastrea rudis*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 161.
1857. *Goniastræa rudis*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 445, pl. D5, fig. 5.
1857. *Prionastræa melicerum*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 521.
1877. *Plesiastræa haeckeli*, Brüggemann, Abh. Ver. Bremen, v, pp. 395—400.
1879. *Prionastræa pentagona*, Klunzinger, Korall. Roth. Meer., iii, p. 41, pl. 4, fig. 11 (non *Astræa pentagona*, Ehrenberg).
1886. *Goniastræa laxa*, Quelch, Reef Corals, Challenger Reports, vol. xvi, part xlvi, p. 102, pl. 3, figs. 4–4*d*.

1904. ? *Goniastræa favus*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 773 (non *Goniastræa favus*, Klunzinger).

1904. *Stephanocœnia maldivensis*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 784.

1904. *Prionastræa pentagona*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 785.

? 1907. *Favia hawaiiensis*, Vaughan, Recent Madreporaria of the Hawaiian Islands and Laysau, U.S. Nat. Mus., Bull. 59, p. 105, pl. 26, figs. 3 and 3*a*.

Corallum. Incrusting or massive, often with low humps. Corallites polygonal. Walls fused, the inter-calicinal partitions thus formed up to 3·6 mm. thick, usually about ·75 or 1 mm., ridged, solid in section. Calices up to 6 mm. in diameter, average 4—5 mm., depth 3—4 mm.

Septa usually thin, sometimes thickened, vertical, with denticulate or entire edges, smooth or slightly rough sides, 20—30 in number, average 22—24, alternating in adjacent corallites or meeting at angles over the walls. 9—14 septa meeting columella, very slightly exsert, each with a bluntly pointed conspicuous paliform lobe. Columella spongy, $\frac{1}{4}$—$\frac{1}{3}$ width of calyx.

Multiplication by unequal fission; when definite walls are formed round the daughter corallites, they appear like buds intercalated among the larger corallites.

Towards edges inter-calicinal walls become thicker (calices then decreasing in width from margins to bases), some of the subsidiary septa so narrow as to be hardly recognisable, columella rudimentary or even absent.

Polyps. (1) Both entocœlic and exocœlic tentacles present. (2) Stomodæal ridges broader than thick (some of them twice as broad as thick), constricted at their bases, and with convex inner surfaces. In contrast to the small size of the polyps their ridges broader than in all the previous species. (3) Seven to nine principal couples of mesenteries. (4) In the stomodæal region of polyps subsidiary couples of mesenteries about twice the number of principal couples. (5) In the stomodæal region of polyp, entocœlic pleats narrow and thick—except towards middle of mesentery where they are much broader, thinner and occasionally sub-divided—and not extending beyond outer two-thirds of width of principal mesenteries; mesenterial mesoglæa thickened only in region of broader pleats, and near stomodæal attachment, elsewhere quite thin. (6) Mesenterial endoderm extremely thin, except on either side of the broader pleats and near the stomodæum. (7) Convolutions of mesenteries never abundant, absent towards base of polyp.

Remarks. A. *Polyps.* These are small, circular or polygonal in outline, with little or no cœnosarc. In one polyp there are 9 principal couples of mesenteries, of which 4 are incomplete; in 2 others 7 couples, of which 2 are incomplete. Subsidiary couples number about 20, of which 5 or 6 reach up to half or two-thirds the width of the principal mesenteries, the remaining couples narrow and hardly extending below the stomodæum. Every tentacle has a swollen terminal battery similar in structure to those of *F. favus*, its nematocysts I having each a spiral of about 33 turns. The stomodæum is oval in outline, its longer diameter measuring about 1·25 mm. Nuclei are not thickly crowded in its ridges as is the case in *F. favus*; occasionally nematocysts I and III are present. The mesoglæa is thickened in each ridge, the fibres passing from the former into the latter, lying close together in the middle of the central non-nucleated granular region.

In the ectoderm of the oral-disc nematocysts I are more frequently found than in the previous species, each with a spiral of about 20 turns; type II are rarely present.

Filaments are attached to the principal mesenteries and to the wider subsidiary ones; they are almost circular in section. A few nematocysts I are present in their straight regions, while II *b* are frequently found in their coils. Below the stomodæal region of polyp the entocœlic pleats extend over almost the entire width of the mesentery, becoming broader towards the skeletal attachments. The endoderm of the oral-disc is never thicker than the overlying ectoderm, in parts only half the thickness of the latter; it has a columnar facies as the nuclei are aggregated along its margin where algæ never occur; the thin circular layer of muscle-fibres is well seen. Both tentacular and stomodæal endoderm are thin with few algæ. Only in some of the mesenteries is the endoderm swollen behind the filaments, where occasionally nematocysts II are seen. The comparative thinness of the endoderm and the scarcity of algæ are distinctive of this species. Ova were present in some of the principal and subsidiary mesenteries in one or two longitudinal rows.

Number of polyps examined, three, from a colony from Hulule, Maldives.

B. *Corallum.* In the Salomon specimens, as also in Klunzinger's example of *Prionastræa pentagona*, up to 5 or 6 of the principal septa tend to become thicker, broader and more exsert than the others; this is particularly evident in some elongated corallites and perhaps shows where division is ultimately to take place. This process is carried further in Gardiner's type of *Favia adduensis*, in which many of the corallites appear either elongated or distorted, in all probability due to delayed fission, the diameters of the calices in such cases being about 6—7 and 4 mm. with 12—14 septa meeting the columella. The latter is a well-formed structure, either closely spongy or quite compact. The corallites towards the edges of this specimen are not elongated and closely resemble those of the Maldive examples of the present species.

Ehrenberg's type of *Astræa melicerum* consists of three incrusting bits on a gastropod shell (Pl. **36**, fig. 4); though somewhat defaced their specific characters may still be recognised. Similar to this is Klunzinger's small figured example of *Prionastræa pentagona*.

In the Paris Museum there are two large specimens named *Prionastræa gibbosissima*, Ed. and H., measuring $22 \times 16 \times 14$ cm. (loc.?) and $38 \times 25 \times 30$ cm. (Red Sea), the former probably the type. Milne Edwards and Haime have also referred two specimens to *Prionastræa melicerum*, one small from Red Sea, the other large ($20 \times 19 \times 19$ cm.) and with low humps from Seychelles (both re-named *Prionastræa pentagona* by Klunzinger); in the latter the calices are about 5 mm. in depth, columella distinct in most corallites, towards edges calices larger up to 6 mm. in diameter, columella rudimentary and paliform lobes conspicuous. Identical with these is another example from Seychelles named *Prionastræa abdita*, later referred by Klunzinger to *Prionastræa pentagona* and also Milne Edwards and Haime's large figured type of *Goniastræa rudis*. A small piece named *Astrangia asiatica*, Mich., in Michelin's collection from East Indies, also belongs to *F. pentagona*.

From Quelch's description of his new species *Goniastræa laxa* from Api, New

Hebrides, it appears he was dealing with two specimens; of these only one (incrusting corallum, measuring 5·5 × 5 cm.), presumably the smaller, was found in the British Museum. It is not in any case a *Goniastrea*, but comes nearest the present species.

Of *Plesiastræa haeckeli*, Brügg., I have seen only two or three corallites, kept in the Berlin Museum; they are similar to those of *Prionastræa melicerum*, Ed. and H.

Localities. Maldives: Hulule (6); Addu (5 small and 1 from 25 fms.); Suvadiva (1 small, 25 fms.). Minikoi (2). Seychelles (4). Saya de Malha (1 small, 29 fms.). Cargados (1 small, 30 fms.). Chagos, Salomon (7). ? Amirante (1, 16 fms.). Providence (1, 29 fms.). Also from Red Sea (Ehrenberg, Milne Edwards and Haime, and Klunzinger), ? New Hebrides (Quelch), ? East Indies (Michelin), ? (Esper).

8. *Favia ananas*, Ellis and Solander. (Pl. **10**, figs. 2 and 4; **25**, fig. 7.)

1786. *Madrepora ananas*, Ellis and Solander, Nat. Hist. Zooph., p. 168, pl. 47, fig. 6 (non *Astrea ananas*, Lamarck).

1857. *Plesiastræa peroni*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 492, pl. D 7, fig. 3 *a* and *b*.

? 1866. *Plesiastrea indurata*, Verrill, Proc. Essex Instit., vol. v, part 3, p. 35, pl. 2, fig. 7.

Corallum. Massive. Corallites circular or oval, with distinct rims. Walls about 1—1·5 mm. thick, meeting in polygonal inter-corallite furrows. Calices 4·5—5 mm. in diameter, about 4 mm. in depth.

Septa thickened towards walls, vertical, with entire or serrate edges, slightly rough sides, exsert to 1 or 1·25 mm., 21—24 in number; of these 8—11 meeting columella, each usually with a blunt somewhat thickened paliform lobe. An alternating cycle of rudimentary septa present. Costæ of main septa conspicuous, with transversely extending granulations, those of rudimentary septa smaller; the former meeting latter or the costæ of the main septa of adjacent corallites in inter-corallite grooves. Columella low, loosely trabecular, $\frac{1}{4}$—$\frac{1}{3}$ width of calyx, sometimes quite rudimentary. Multiplication by fission.

Polyps. (1) Both entocœlic (only over principal entocœles) and exocœlic tentacles present. (2) Stomodæal ridges thicker than broad, with convex inner surfaces. (3) Seven principal couples of mesenteries. (4) In the stomodæal region of polyps about as many subsidiary couples of mesenteries as there are principal couples. (5) In the same region of polyp entocœlic pleats thick, usually unconstricted at their bases, undivided, extending over the greater part of width of principal mesenteries, broader and thicker in outer half of width; mesenterial mesoglæa comparatively thick, usually stouter in its outer half. (6) Mesenterial endoderm vacuolated, considerably swollen, of more or less uniform thickness along entire width of mesenteries. (7) Convolutions of mesenteries abundant from stomodæum to base of polyp massed in inter-mesenteric chambers, almost blocking the whole gastro-vascular cavity.

Remarks. A. *Polyps.* These are circular or oval in shape and small in size. Four have each 7 principal couples of mesenteries, of which 3 are incomplete; a smaller polyp has only 5 principal couples; about 10 subsidiary couples are present, 3 or 4 of which do not extend below the stomodæum. The tentacles are short, present over all the exocœles but only over the principal entocœles, the latter larger than the former; every tentacle has a swollen terminal battery containing a fair number of nematocysts II *b*

in addition to closely packed nematocysts I, the larger ones having 40 to 50 turns of the spiral; sub-terminal batteries number 3 or 4. The stomodæum is laterally compressed with its diameters in the retracted condition measuring 1·25 and ·75 mm.; owing to the radial contraction of the mesenteries some of the ridges are pulled outwards, appearing somewhat concave in transverse section. Small nematocysts I, similar to those in the oral-disc, are present in the stomodæal ridges, in which the mesoglæa is not thickened. In the ectoderm of the oral-disc numerous mucous vacuoles are present; small nematocysts I are fairly frequent, but II are scarce.

Filaments are present on all the mesenteries; nematocysts I occur in their straight regions as in the stomodæal ridges, but have fewer coils; where numerous, nematocysts III are arranged in rows, many with threads partly discharged; some of type II, with the axes usually bent a little, are also found. Convolutions of the mesenteries are protruded into the stomodæum. The endoderm is, as a rule, much vacuolated; in the oral-disc it is as thick as the ectoderm over it; in the tentacles it fills their lumina. The gastro-vascular cavity is blocked below the stomodæum owing to the swollen condition of the mesenterial and column-wall endoderm and to the abundance of the mesenterial convolutions. Algæ are massed together in the endoderm of the oral-disc and tentacles, scarce in the mesenterial endoderm. Gonads were not present in any of the polyps. Number of polyps examined, five, all from one colony from Dongonab, Red Sea.

B. *Corallum.* Ellis and Solander's figured type of *Madrepora ananas* is missing from the University Museum, Glasgow, but judging from the figure there is little doubt I am dealing with a specimen similar to theirs. Since *Madrepora ananas* of Linnæus is, according to Milne Edwards and Haime, a Cyathophyllid = *Acervularia ananas* (Corall. iii, p. 412), Ellis and Solander's specific name may be retained for the present species. Milne Edwards and Haime's original of *Plesiastræa peroni* is missing, but their figure resembles my specimen, the only difference being that in the former the corallites appear to project more.

Verrill's figure of his species, *Plesiastræa indurata*, greatly resembles my type specimen, but his specimens have to be examined before the relationship of his species to the present can be finally settled.

Localities. Red Sea (1 small). Also known from ? Australia (Milne Edwards and Haime), ? Loo Choo Islands (Verrill), ? loc. (Ellis and Solander).

9. *Favia laxa* (Klunzinger). (Pl. **24**, figs. 5 and 6; **37**, fig. 2.)

1879. *Orbicella laxa*, Klunzinger, Korall. Roth. Meer., iii, p. 49, pl. 5, fig. 3, pl. 10, figs. 9*a* and 9*b* (non *Orbicella laxa*, Gardiner).

Corallum. Massive, tending to be rounded off, sometimes incrusting. Peritheca vesicular, the dissepiments about ·75 mm. apart. Corallites circular or laterally compressed, projecting about 1 mm., sometimes almost level, with distinct rims, usually about 1—2 mm. apart, always separated by inter-corallite furrows. Calices 4—6 mm. in diameter depth 2—3 mm.

Septa thickening towards walls, usually vertical, with toothed edges, crowded blunt spinules on sides, exsert to ·5 or ·75 mm., up to 37 in number, average 32; of these

12—17 meeting columella, each with a blunt paliform lobe and 3 or 4 blunt teeth above it, usually perforated behind paliform lobes. Subsidiary septa alternating with the principals, the broader ones curving towards and fusing with sides of principals. Exsert ends of septa arched, serrate. Costæ with transversely extending granulations, usually meeting in inter-corallite furrows, tending to be united by transverse ridges where they meet. Columella well developed, trabecular, about $\frac{1}{3}$ width of calyx.

Multiplication by equal or sub-equal fission.

The corallites towards the edges project up to 3·5 mm. and increase in diameter from calicular margins (6 or 7 mm.) to bases (9 mm.). They are wider apart, up to 6 mm., with calices shallower, septa sloping, thicker and rougher, and with usually an alternating cycle of smaller costæ, hardly represented by septa within.

The skeletal facies of this species has a general resemblance to that of *Echinopora gemmacea*.

Polyps. (1) Both entocœlic and exocœlic tentacles present. (2) Stomodæal ridges narrow, thicker than broad, as in *Favia hululensis*, inner surface slightly convex or flat. (3) About nine principal couples of mesenteries. (4) In the stomodæal region of polyp about as many subsidiary couples of mesenteries as there are principal couples. (5) In the stomodæal region of polyp, entocœlic pleats thick, undivided, slightly constricted at their bases, narrow on outer half of pleatal region, directed obliquely towards the stomodæum and extending over outer halves of principal mesenteries; pleatal region of mesoglæa thicker than non-pleatal region, inner half of former stouter than its outer half and with broader pleats. (6) Mesenterial endoderm thicker in pleatal region. (7) Convolutions of mesenteries not abundant, but extending to base of polyp.

Remarks. A. *Polyps.* The polyps of this species were not in a good condition for detailed study. 9 principal couples of mesenteries were present in each of 3 polyps, 7 and 8 couples in two others; of these, 1 to 5 couples were incomplete; subsidiary couples numbered 8 to 10. The tentacles were short, with well-developed terminal batteries of the usual structure and with not more than 4 or 5 sub-terminal ones. The stomodæum is oval in transverse section, its diameters in the retracted condition being 1·5 and 1 mm.; owing to the radial contraction of the mesenteries some of the ridges appear concave in transverse section; the mesoglæa is not thickened in the ridges. The endoderm in the tentacles and stomodæal wall is quite thin. Gonads were not present in any of the polyps.

Number of polyps examined, five, 3 from one colony and 2 from a second, both from Dongonab, Red Sea.

B. *Corallum.* Klunzinger's type of *Orbicella laxa* is a small specimen measuring $10 \times 9 \times 4$ cm. In the Hofmuseum, Vienna, are three specimens of the "Pola" expedition, referred by Marenzeller to *Orbicella laxa*, Klunz. Two of these are large examples, one from Sherm Abban (No. 15916) measuring $19 \times 19 \times 15$ cm., the other from Koseir (No. 2276) measuring $30 \times 16 \times 8$ cm.

Locality. Red Sea (5). Not recorded from elsewhere.

10. *Favia hirsuta* (Milne Edwards and Haime). (Pl. **24**, figs. 7 and 8.)

1816. *Astræa dipsacea*, Lamarck, Hist. Anim. sans vert., ii, p. 262.

1833. *Astræa dipsacea*, Quoy and Gaimard, Voy. l'Astrol., Zooph., p. 210, pl. 17, figs. 1—2.
1834. *Astræa dipsacea*, Ehrenberg, Corall. roth. Meer., p. 97.
1850. *Acanthastrea hirsuta*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 145.
1850. *Acanthastrea spinosa*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 145.
1850. *Acanthastrea brevis*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 146.
1850. *Acanthastrea grandis*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 146.
1857. *Acanthastræa hirsuta*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 502, pl. D5, fig. 4.
1857. *Acanthastræa spinosa*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 502.
1857. *Acanthastræa brevis*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 503.
1857. *Acanthastræa grandis*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 504.
1879. *Acanthastræa hirsuta*, Klunzinger, Korall. Roth. Meer., ii, p. 42, pl. 5, figs. 1 and 2.
1886. *Acanthastræa irregularis*, Quelch, Reef Corals, Challenger Reports, Zool., vol. xvi, part xlvi, p. 102, pl. 4, figs. 2—2*a*.
1899. *Prionastræa hirsuta*, Gardiner, Proc. Zool. Soc. London, p. 760.
1904. *Acanthastræa hirsuta*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 784, pl. 59, fig. 6.

Corallum. Partly incrusting, partly massive. Corallites polygonal. Walls fused, the inter-calicinal partitions thus formed up to 9 mm. in thickness, average about 4 mm., and dense in section. Calices varying much in size, average diameters 18 × 13 mm. (the largest calyx measuring 25 × 11 mm.), depth up to 15 mm., usually about 11 mm., decreasing in width from calicular margins to bases.

Septa thick, swollen in thecæ, sloping, with strongly-toothed edges, almost smooth sides, exsert to 2—3mm., 35—50 in number of these 13—18 meeting columella, with 7—12 bluntly-pointed more or less triangular hollow teeth, the first upright, swollen at its base, forming the most exsert part of each septum; teeth about 2 mm. apart at the upper part, 1 mm. towards columella, the lowest tooth usually swollen. Exsert ends of septa of adjacent corallites meeting in notches or alternating, hence inter-calicinal walls appearing furrowed above. The broader subsidiary septa curving towards and fusing with sides of principals. Columella formed of intercrossing septal teeth, mostly upright. Calicular dissepiments passing from wall to columella at an angle of 45°, about 2 mm. apart.

Multiplication by unequal fission towards calicular margins.

Polyps. A small specimen in spirit which, on the authority of Prof. Gardiner, was taken from the figured example of var. *megalostoma*, had to be entirely decalcified, as it possessed only two polyps. Owing to the lack of sufficient material and as the sectioning of the two polyps was not quite successful, only a short description of the anatomy is given below: Both entocœlic and exocœlic tentacles present, each with a swollen terminal battery having the usual structure (most of the II *b* nematocysts are in their earlier stages of development, the axes being very short and their nuclear origin quite apparent) and up to eight sub-terminal batteries with vacuoles in their sides; nematocysts I with about 40 turns of the spiral. Tentacular endoderm vacuolated with algæ scarce, hence almost transparent. In vertical sections the tentacles greatly resembling those of *Favia doreyensis*, Ed. and H. Stomodæal ridges thicker than broad, with convex inner surfaces. In the larger polyp 13 principal couples of mesenteries and 23 subsidiary couples are present, in the smaller polyp 12 and 5. In the stomodæal region of the polyp the entocœlic pleats thick, unconstricted at their bases, sometimes sub-divided, always close together and directed obliquely towards the stomodæum, and extending to not more than the middle of a principal mesentery, better developed in its outer one-third; very narrow

exocœlic pleats for a short distance from the stomodæal attachment. Mesenterial endoderm quite thin and of more or less uniform thickness along the entire width of the mesentery. Convolutions of the mesenteries abundant below the stomodæum to the base of the polyp, being massed in the inter-mesenteric chambers. Filaments are found on all the mesenteries. In the larger polyp ova present, in up to five rows in every mesentery, with the endoderm granular and swollen on either side of them.

Number of polyps examined, two, from a specimen from Hulule, Maldives.

Remarks. Milne Edwards and Haime placed *Astrea dipsacea*, Audouin (Expl. Savignyi, Descr. l'Egypte, xiii. p. 57, pl. 5, fig. 3, 1809), under *Favia savignyi*, Ed. and H. I have not been able to see this example. If Klunzinger is correct in identifying it with *Acanthastræa hirsuta*, then the present species would be named *F. dipsacea*.

Of the five specimens now in the Berlin Museum referred by Ehrenberg to *Astrea dipsacea*, only one (later re-named *Acanthastræa hirsuta* var. *megalostoma* by Klunzinger) comes under the present species. Klunzinger's figured example of var. *megalostoma* is not in the Berlin Museum.

Milne Edwards and Haime named 7 specimens (3 large, one with the *microstoma* facies, and 4 small, all from Red Sea) *Acanthastræa hirsuta*, Ed. and H., 4 specimens (2 large and 2 small, from unknown locality) *Acanthastræa brevis*, Ed. and H., and 4 large specimens (3 from Red Sea and 1 from unknown locality) *Acanthastræa grandis*, Ed. and H.; I could not find any differences separating these three species. They also named two very small specimens from Tongatabou *Acanthastræa spinosa*, Ed. and H., these doubtless also belonging to the present species. Lamarck's original of *Acanthastræa dipsacea* is similar to the *megalostoma* examples. A specimen from Red Sea named *Cœloria bottæ*, Ed. and H., also comes under the present species. Quelch's type of his new species, *Acanthastræa irregularis*, is a small, thin, convex specimen from Kandavu, Fiji, measuring 7 × 7·5 cm., in no way different from the *hirsuta* examples.

Localities. Maldives, Hulule (1). Red Sea (1). ?Ellice Islands, Funafuti (a fragment). Also from Tongatabou (Milne Edwards and Haime), Fiji (Quelch).

11. *Favia acropora* (Linnæus). (Pl. **25**, figs. 1 and 3; **26**, fig. 4; **33**, fig. 1.)

1767. *Madrepora acropora*, Linnaeus, Syst. Nat., edit. 12, p. 1276.
1788. *Madrepora acropora*, Gmelin, Linn. Syst. Nat., edit. 13, p. 3767.
1797. *Madrepora acropora*, Esper, Forts. Pflanz., p. 21, pl. 38, figs. 1 and 2.
1815. *Favia acropora*, Oken, Lehrb. Naturg., i, p. 68.
1816. *Astrea pleiades*, Lamarck, Hist. Anim. sans vert., ii, p. 261; 2e édit., p. 408 (non *Madrepora pleiades*, Ellis and Solander).
1850. *Astrea pleiades*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 105.
1850. *Parastrea lobata*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 171.
1857. *Favia lobata*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 434, pl. D8, fig. 3.
1857. *Heliastræa acropora*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 477.
1879. *Favia lobata*, Klunzinger, Korall. Roth. Meer., ii, p. 31, pl. 3, fig. 9, pl. 10, fig. 8.
1899. *Astræa lobata*, Gardiner, Proc. Zool. Soc. London, p. 749.
1899. *Orbicella acropora* (pars), Gardiner, Proc. Zool. Soc. London, p. 752.
1899. *Orbicella orion*, Gardiner, Proc. Zool. Soc. London, p. 752.
1906. *Orbicella lobata*, Marenzeller. Exp. "Pola." Roth. Meer., Riffkorall., Zool. Ergeb. Wien xxvi, p. 61.

Corallum. Massive, rising into hillocks, which usually decrease in thickness from their summits. Peritheca vesicular or compact. Corallites circular, dividing ones

elongated, slightly projecting, with distinct rims, usually ·5—1 mm. apart (towards edges of corallum up to 2·5 mm.), separated by somewhat polygonal furrows. Calices varying little in size, 2 or 2·5 mm. in diameter, shallow, not more than 1 mm.

Septa thickening towards walls, with vertical ragged edges, spinulose or coarsely rough sides, ·5—·75 mm. exsert, 14—24 in number, 7—13 meeting columella, narrow,—some of these sometimes thicker than the others—mostly with rough, blunt paliform lobes, perforated behind. Exsert ends of septa arched. Costæ conspicuous, spinulose, usually stopping at inter-corallite grooves, sometimes those of adjacent corallites meeting in notches. A cycle of very narrow septa alternating with the principals and subsidiaries usually without costæ. Columella varying in texture, being compact or spongy, and $\frac{1}{5}$—$\frac{1}{2}$ width of calyx, in some corallites quite rudimentary.

Multiplication by unequal or equal fission.

The hillocky mode of growth and the shape of the hillocks are quite characteristic of this species. It is also comparatively compact, varying only within narrow limits.

The polyps were all in a badly-preserved condition; two were sectioned from a specimen from Rotuma, in one of them 6 principal couples of mesenteries and 9 subsidiary couples were counted. Tentacles were present over all the entocœles and exocœles.

Remarks. *Corallum.* In the Paris Museum there are 2 specimens from the Indian Ocean, referred by Milne Edwards and Haime to *Heliastræa acropora*, one a broken off hump (15 × 11 cm.), the other a large hillocky specimen (23 × 19 × 16 cm., Pl. **26**, fig. 4), and 4 examples from Red Sea (all humps, the largest 10 × 7·5 cm.) to *Favia lobata*. In the Berlin Museum are small examples referred by Klunzinger to *Favia lobata*, 2 of which he has figured. Marenzeller has assigned 3 specimens of the "Pola" expedition to *Orbicella lobata*, one of which, measuring 48 × 37 × 26 cm., is an excellent example with crowded hillocks, the latter up to 10 cm. high.

Localities. Chagos: Salomon (13); Egmont (2). Amirante (1 from over 25 fms.). Seychelles (1). Aldabra (1). Funafuti (3). Rotuma (1). Also from Red Sea (Milne Edwards and Haime, Klunzinger and Marenzeller), ? loc. (Esper, Linnæus and Oken).

12. *Favia versipora* (Lamarck). (Pl. **23**, fig. 3; **25**, figs. 5, 6 and 9; **37**, fig. 3.)

1816. *Astrea annularis*, var. 2, Lamarck, Hist. Anim. sans vert., ii, p. 259; 2e édit., p. 405 (non *Madrepora annularis*, Ellis and Solander).
1816. *Astrea versipora*, Lamarck, Hist. Anim. sans vert., ii, p. 264; 2e édit., p. 414.
1830. *Dipsastrea versipora*, Blainville, Dict. Sci. Nat., lx, p. 338; Man. d'actinol., p. 373.
1833. *Astrea annularis*, Quoy and Gaimard, Voy. l'Astrol., Zooph., p. 210, pl. 17, figs. 17—18.
1850. *Astrea laperousiana*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 101.
1850. *Astrea annuligera*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 103.
1850. *Plesiastrea versipora*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 118 (non *Orbicella versipora*, Gardiner).
? 1850. *Plesiastrea quatrefagiana*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 119.
1857. *Heliastræa laperouseana*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 460.
1857. *Heliastræa annuligera*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 471.
1857. *Plesiastræa versipora*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 490, pl. D7, fig. 5.
? 1857. *Plesiastræa quatrefagesana*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 491.
1899. *Orbicella acropora* (pars), Gardiner, Proc. Zool Soc, p. 752.
1899. *Orbicella annuligera*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 774, pl. 63, fig. 32.

Corallum. Incrusting. Peritheca compact. Corallites circular, unless dividing when elongated, projecting up to 1·5 mm., usually to ·75 or 1 mm., up to 1·5 mm. apart, usually closer but separated by inter-calicinal grooves. Calices 3—4 mm. in diameter, 1—2 mm. in depth.

Septa comparatively thin, vertical (edges somewhat concave in the shallower calices), with denticulate edges, spinulose sides, exsert to ·5—·75 mm., 16—25 in number; 12—18 septa meeting columella, most of these with rough blunt paliform lobes (usually a ring of 12), which in shallower calices reach to the calicular margins; subsidiary septa often curving towards and fusing with sides of principals. Exsert ends of septa arched, denticulate. Generally a cycle of very narrow septa alternating with the principals and subsidiaries, with or without corresponding costæ. Costæ conspicuous with transversely extending granulations, stopping at inter-corallite grooves or meeting those of adjacent corallites in notches. Columella spongy or dense, $\frac{1}{4}$—$\frac{1}{2}$ width of calyx.

Multiplication by budding (small corallites intercalated between larger ones) and by fission.

The polyps were all badly preserved. Though budding undoubtedly takes place among them, neither of the polyps sectioned from a specimen from Rotuma had any directive couples of mesenteries; one of them had 6 principal couples of mesenteries and 19 subsidiary couples. In its stomodæal region the entocœlic pleats were narrow and did not extend beyond the outer one-third of each principal mesentery. Tentacles were present over all the entocœles and exocœles.

Remarks. *Corallum.* In the Paris Museum is a small incrusting specimen (6·5 × 6 cm.) from Australia, Milne Edwards and Haime's *Heliastræa annuligera* (Pl. **37**, fig. 3), with which Gardiner's figured examples of *Orbicella annuligera* are identical. Two other specimens are named by them *Plesiastræa versipora*, Ed. and H., one from Indian Ocean measuring 10 × 5 × 3·5 cm. (Pl. **23**, fig. 3), the other smaller from an unknown locality; in the latter and on one side of the former the corallites are closer and with polygonal inter-corallite furrows. *Plesiastræa quatrefagesana*, Ed. and H., is represented by a small specimen with rudimentary paliform lobes from an unknown locality. In all these specimens multiplication is mainly by budding. Milne Edwards and Haime's types of *Heliastræa laperouseana* are two small incrusting specimens from Vanikoro, which perhaps belong here (Pl. **25**, fig. 9).

A badly-cleaned fragment in the "Challenger" collection, with five or six corallites from Bermuda, referred by Quelch to *Astræa coarctata* (Duchassaing and Michelotti), comes nearest the present species.

Localities. Maldives, Goidu (2). Minikoi (3). Seychelles (3). Chagos, Salomon (9). Rotuma (1). Also from Australia and Vanikoro (Milne Edwards and Haime); ? Bermuda (Quelch).

13. *Favia wakayana* (Gardiner). (Pl. **25**, fig. 4.)

1899. *Orbicella wakayana*, Gardiner, Proc. Zool. Soc. London, p. 753, pl. 49, fig. 2.

1899. *Orbicella versipora*, Gardiner, Proc. Zool. Soc. London, p. 753 (non *Plesiastræa versipora*, Milne Edwards and Haime).

1899. *Orbicella heliopora*, Gardiner, Proc. Zool. Soc. London, p. 756, pl. 49, fig. 4 (non *Heliastræa heliopora*, Milne Edwards and Haime).

1899. *Orbicella solidior*, Gardiner, Proc. Zool. Soc. London, p. 756 (non *Heliastræa solidior*, Milne Edwards and Haime).

1899. *Orbicella funafutensis*, Gardiner, Proc. Zool. Soc. London, p. 756, pl. 49, fig. 5.

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Corallum. Usually incrusting, sometimes massive. Corallites circular, oval or sometimes laterally compressed, projecting up to 3·5 mm., usually 1·5 or 2 mm., in some specimens with one side higher than the other as in *F. doreyensis*. Corallites usually closely arranged but always with inter-corallite grooves, towards edges up to 3 mm. apart. Calices about 4—5 mm. in diameter, when laterally compressed up to 8 × 5 mm., depth 3—5 mm.

Septa thickening towards theca, vertical or slightly sloping, with toothed edges, spinulose or coarsely rough sides, slightly exsert, 17—25 in number, 10—18 meeting columella, each usually with a blunt paliform lobe and perforated behind it; 3—7 of the principal septa, as a rule, somewhat broader, thicker and rougher than the others (the degree of thickness varying in different examples), with conspicuous paliform lobes, and exsert up to 1 or 1·5 mm. The subsidiary septa often curving towards and fusing with sides of principals. Exsert ends of septa arched, rarely flat, serrate. An alternating cycle of very narrow septa present, with smaller costæ. Costæ conspicuous, toothed, usually meeting in inter-corallite grooves. Columella formed of septal trabeculæ, varying in degree of development, from $\frac{1}{6}$ to $\frac{1}{3}$ width of calyx and from being loosely spongy to compact.

Multiplication by budding—the small corallites formed in this manner are found intercalated between the ordinary ones—rarely also fission.

Towards edges corallites are wider apart, up to 3 mm., and shallower.

The skeletal facies of the present species has a general resemblance to that of *F. laxa*.

The polyps of this species were in a badly-preserved condition. In three polyps sectioned (taken from a specimen from Rotuma resembling Gardiner's example of *Orbicella wakayana*) tentacles were present over all the entocœles and exocœles; 8—10 couples of principal mesenteries and 11—14 subsidiaries were counted. Entocœlic pleats were broader than in *F. versipora* and extended to about the middle of each principal mesentery.

It is likely that the present species may have been previously recorded by Dana, but this point cannot be settled till Dana's Astræid types are examined. A fairly large specimen from Kandavu, Fiji, in the "Challenger" collection, which Quelch has referred to *Plesiastræa indurata*, Verrill, is identical with Gardiner's examples of *Orbicella wakayana*.

Localities. Funafuti (8). Fiji, Wakaya (3). Rotuma (1). Known only from the Pacific Ocean.

14. *Favia solidior* (Milne Edwards and Haime). (Pl. **25**, fig. 8; **28**, fig. 1.)

1850. *Astrea solidior*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 102.

1857. *Heliastræa solidior*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 466.

1899. *Orbicella curta*, Gardiner, Proc. Zool. Soc. London, p. 754.
1899. *Orbicella coronata*, Gardiner, Proc. Zool. Soc. London, p. 754.
1899. *Orbicella rotumana*, Gardiner, Proc. Zool. Soc. London, p. 755, pl. 49, fig. 3.
? 1904. *Orbicella curta*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 776.

Corallum. Incrusting. Corallites circular or oval, projecting more than in *F. wakayana*, average 2·5 or 3 mm., with conspicuous rims and separated by deep grooves. Calices from 5—8 mm. in diameter, depth about 5 mm.

Septa thickening towards theca, almost vertical, with toothed edges, spinulose or granular sides, exsert to about ·75 or 1 mm., 20—28 in number; 9—15 septa meeting columella, average 10—13, each usually with a paliform lobe behind which it is perforated, 6—8 of the principal septa broader and thicker than in *F. wakayana* (this being a marked feature of the species) and exsert up to 2 mm. An alternating cycle of very narrow septa present, with smaller costæ. Costæ conspicuous, more or less flat ridges, varying in thickness in accordance with their septa, with transversely extending granulations usually meeting in inter-corallite grooves. Columella poorly developed, spongy, $\frac{1}{5}$—$\frac{1}{4}$ width of calyx.

Multiplication as in *F. wakayana* by budding, rarely aided by fission.

This species is a larger and thicker edition of *F. wakayana*.

Milne Edwards and Haime's type of *Heliastræa solidior* is a small specimen (7 × 4·5 × 5 cm., Pl. **25**, fig. 8) from Tongatabou, similar to Gardiner's example of *Orbicella coronata*.

Localities. Funafuti (2). Rotuna (1). ? Maldives, Mahlos madulu (a fragment). Also from Tongatabou (Milne Edwards and Haime).

15. *Favia halicora* (Ehrenberg). (Pl. **26**, figs. 3 and 5—7.)

1834. *Astræa halicora*, Ehrenberg, Corall. roth. Meer., p. 96 (non *Prionastræa halicora*, Milne Edwards and Haime).
1879. *Goniastræa halicora* var. *acuta*, Klunzinger, Korall. Roth. Meer., iii, p. 33, pl. 4, fig. 1.
1889. *Favia ehrenbergi*, Ortmann, Steinkorall. süd. Ceylons, Zool. Jahrb., iv, p. 526 (non *Favia ehrenbergi*, Klunzinger).
1904. *Favia halicora*, forma *obtusa*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 771.
1904. *Prionastræa crassior*, Gardiner, Fauna Geogr. Maldives and Laccadives, ii, p. 786, pl. 64, figs. 45 and 46 (non *Prionastræa crassior*, Milne Edwards and Haime).

Corallum. Incrusting or massive. Corallites polygonal, sometimes oval or circular, level or projecting to 1—2 mm., usually separated by polygonal furrows. Walls ·75—2 mm. in thickness. Calices oval or circular, sometimes polygonal, with diameters 9—11 mm. and 7—8 mm. (when circular 6—8 mm.), depth 3—6 mm.; much shallower towards edges of corallum.

Septa thin in calices, thickened or swollen in theca, up to 1 mm., with toothed edges, slightly rough to spinulose sides, exsert up to 1 mm., 25—40 in number, average about 30; of these up to 20 meeting columella, usually 15—17, with upper two-thirds or half narrow and usually vertical; on each septum 6—10 teeth, longer and closer together towards columella; lower one-third or half of principals much broader, these or the ring of last septal teeth forming a pali-crown. Septa oblique in some of the calices—particularly in the shallower calices. Subsidiary septa usually curving towards and fusing with sides of

principals, a group of 1—4 meeting a principal septum. Costæ conspicuous when inter-corallite grooves are present, with transversely extending granulations; alternating with these a cycle of smaller costæ represented by very narrow septa in the thin-walled corallites; costæ of neighbouring corallites meeting in inter-corallite grooves, directly continuous over walls when grooves are absent. Columella formed of closely-twisted trabeculæ, up to $\frac{1}{3}$ width of calyx, usually $\frac{1}{5}$—$\frac{1}{4}$ width.

Multiplication by very unequal fission towards calicular margins. When walls are formed round the small fission-products, they simulate buds.

This species has a variable skeletal facies. Between the thin-walled polygonal level corallites without surrounding grooves and the oval or circular thick-walled corallites with distinct furrows there are many intermediate stages. (Compare Pl. **26**, figs. 5—7.)

Gardiner's example (2) of *Favia halicora*, forma *obtusa*, is missing.

Some of my examples from Salomon show a certain resemblance to *Favia abdita* in having an alternating cycle of very narrow septa in every corallite and in fission being marginal. The dredged specimen from Peros, Diamant, has further the hillocky mode of growth so characteristic of *Favia abdita*.

The two large specimens from Aldabra are identical with Ehrenberg's type of *Favia halicora* (= *Goniastræa halicora* var. *acuta*, Klunz.).

In the two small specimens referred by Gardiner to forma *acuta*, Klunz., the inter-calicinal walls are thinner (about 1 mm.), the calices smaller (about 6 mm. in diameter), and the total number of septa is less (22—26) than in the large specimen which he assigned to *obtusa*. Nevertheless, they belong to the present species.

Ehrenberg's original of *Astræa halicora*, which Klunzinger re-described and figured as the type of *Goniastræa halicora* var. *acuta*, is a large example (Mus. No. 733) measuring 25 × 21 × 16 cm., in most parts without inter-corallite grooves. Identical with this are my two large examples from Aldabra. The specimen from Ceylon which Ortmann referred to *Favia ehrenbergi* measures 23 × 16 × 10 cm.

Localities. Maldives: Hulule (1); Goidu (1); Turadu (1). Minikoi (3). Chagos: Salomon (9); Egmont? (1); Peros, Diamant (1 from 15 fms.). Aldabra (2 from lagoon reefs). Cœtivy? (1). Singapore (1). Also from the Red Sea (Ehrenberg) and Ceylon (Ortmann).

16. *Favia hombroni* (Rousseau). (Pl. **26**, figs. 1 and 2; **33**, fig. 2.)

1854. *Parastræa hombronii*, Louis Rousseau, Voy. au pôle Sud de Dumont-d'Urville, Zool., v, p. 122, Zooph. pl. 28, fig. 3.
1857. *Favia hombroni*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 435.
1866. *Astrea* (*Favia*) *hombroni*, Verrill, Proc. Essex Inst., v. p. 33.
1904. *Favia hombroni*, Gardiner, Fauna Geogr. Maldives and Laccadives, ii, p. 771, pl. 62, fig. 27.

Corallum. Massive, often becoming rounded off. Peritheca more or less compact. Corallites polygonal, close together, with margins very thin when distinct, otherwise inter-calicinal walls flat. Calices with diameters about 3—4 mm. and 2·5—3·5 mm., depth 2—2·5 mm. Calicular dissepiments about 1·25 mm. apart.

Septa of even thinness along their entire breadth, with vertical, entire or finely-

serrate edges, smooth or slightly rough sides, 17—24 in number, average about 20; 5—10 septa meeting columella, usually 6—8, exsert about ·75 mm., most of them with slender paliform lobes. Most of the subsidiary septa narrow. Usually an alternating cycle of rudimentary septa present, recognisable only with a lens. Septa continuous from corallite to corallite, their exsert ends being flat or slightly arched, giving a characteristic appearance to the corallum. Columella usually rudimentary, formed of a few septal trabeculæ.

Fission equal or sub-equal.

A species showing comparatively little variation of the corallum.

Milne Edwards and Haimes' type of *Favia hombroni* from "Oceanie?" is a large specimen measuring 23 × 16 × 11 cm., in every respect resembling my examples.

Localities. Maldives, Hulule (1). Minikoi (1). Chagos: Salomon (8). Also known from Oceania (Milne Edwards and Haime), ? Sandwich Islands (Verrill).

17. *Favia vasta* (Klunzinger). (Pl. **27**, figs. 3, 5 and 6.)

1879. *Goniastræa halicora* var. *obtusa*, Klunzinger, Korall. Roth. Meer., iii, p. 33, pl. 4, fig. 2, and pl. x, figs. 3*a* and *b*.

1879. *Prionastræa vasta*, Klunzinger, Korall. Roth. Meer., iii, p. 38, pl. 4, figs. 8 and 12, pl. 10, figs. 4*a* and *b*.

Corallum. Massive, more or less flat. Corallites polygonal, usually hexa- or pentagonal, with walls of neighbouring ones fused, the inter-calicinal partitions thus formed 1·5—2·5 mm. in thickness. Calices widest at the calicular openings, with diameters up to 22 and 15 mm., depth up to 13 mm.

Septa sloping or with upper two-thirds or halves vertical and narrower, those of adjacent corallites continuous over inter-calicinal walls, being exsert to 1 or 1·5 mm., with edges well toothed, sides rough or sometimes smooth, up to 55 in number (average about 40); of these up to 24 meeting columella (average about 20), each with 8—10 teeth becoming longer towards columella, the lower somewhat broader parts of the septa with the longer teeth sometimes simulating a pali-crown. The subsidiary septa often curving towards and fusing with sides of principal septa, up to 3 or 4 meeting one of the latter. An alternating cycle of very narrow septa invariably present, those of neighbouring corallites being continuous over inter-calicinal walls; hence from surface a characteristic alternating appearance of high and low septal arches. Columella formed of closely-twisted trabeculæ, often rising into points.

Multiplication by marginal fission.

Klunzinger has described two varieties of *Prionastræa vasta*. In one (Pl. 4, fig. 12, type measuring 8 × 7 × 4·5 cm.) the corallites are deep, with their diameters not very unequal, the septa somewhat thin and the columellæ well developed. Agreeing with this are two of my specimens from Salomon (the larger measuring 13 × 8 × 4 cm.) with calices about 20 × 15 cm. wide and 10—12 mm. deep (Pl. **27**, fig. 5). These resemble *Favia abdita* (Ell. and Sol.) in (1) marginal fission, (2) the subsidiary septa usually fusing with the sides of the principal septa in groups of up to 3 or 4, (3) an almost equal number of septal teeth of similar appearance to *F. abdita*, (4) the invariable presence of an alternating cycle of very narrow septa, and (5) the columellæ formed of closely-twisted

trabeculæ; but the corallites are much larger than in *F. abdita*, the septa thicker and further apart, and the alternating septa meet their fellows over the walls and not the main septa of the adjacent corallites.

Klunzinger's var. *superficialis* (Pl. 4, fig. 8, type measuring $9 \times 5{\cdot}5 \times 5$ cm.) has shallow corallites about twice as long as broad, average diameters 20 and 10 mm., inter-calicinal walls and septa thicker, and the columellæ either rudimentary or absent. This variety approaches *Favia hirsuta* (Ed. and H.) in the following respects: (1) heavy corallum, presenting a similar appearance in transverse section, (2) the inter-calicinal walls, septa and septal teeth thickened but not to the same extent (septal sides almost smooth), (3) the corallites with similar shape, being widest at the calicular openings and gradually narrowing towards the bases. Resembling Klunzinger's type is one of my specimens from Egmont, Chagos, measuring $23 \times 13 \times 11$ cm. (Pl. **27**, fig. 3), but in the latter the columellæ are well formed, of twisted septal trabeculæ.

Klunzinger's var. *obtusa* of *Goniastræa halicora* (type measuring $18 \times 10 \times 4$ cm.) has the same facies as his *Prionastræa vasta* (Pl. IV, fig. 12), but has a somewhat thinner build and smaller corallites. Resembling this type are two of my specimens, with incrusting coralla: one from Aldabra ($11{\cdot}5 \times 10{\cdot}5$ cm., Pl. **27**, fig. 6), which has thin sharp-ridged inter-calicinal partitions (not more than 1 mm. in thickness), calices about 15×10 mm. wide by 8 or 9 mm. deep, with more or less distinct pali-crowns; the other, from Salomon, smaller, but with thicker walls and septa.

In the Paris Museum are two large specimens of *Prionastræa vasta*, Klunz., from Koseir, representing Klunzinger's two varieties, and also a good example of *Goniastræa halicora* var. *obtusa* from the same locality.

Localities. Chagos: Salomon (3); Egmont (1). Aldabra (1). Previously recorded only from the Red Sea.

18. *Favia complanata*, Ehrenberg. (Pl. **30**, figs. 1—3.)

1834. *Favia complanata*, Ehrenberg, Corall. roth. Meer., p. 93.
1834. *Astræa tesserifera*, Ehrenberg, Corall. roth. Meer., p. 97.
? 1846. *Astræa tesserifera*, Dana, Expl. exp. Zooph., p. 248, pl. 13, fig. 9.
1850. *Prionastrea michelini*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 132.
1851. *Prionastrea tesserifera*, Milne Edwards and Haime, Pol. foss. terr. palæoz., etc., p. 102.
1857. *Prionastræa tesserifera*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 517.
1879. *Prionastæa tesserifera*, Klunzinger, Korall. Roth. Meer., iii, p. 37, pl, 4, fig. 9.

Corallum. Incrusting, following irregularities on surface of attachment, often rising into hillocks, which usually end in ridges with corallites on either side of each such ridge from light to heavy, and with a thorny appearance, generally distorted. Corallites polygonal, on the hillocks, with one side much higher than the other, in the narrow valleys with a tendency to be drawn out, more regular in shape on the level regions. Inter-calicinal walls varying from very thin and sharp to 5 or 6 mm. broad. Calices with diameters up to 18 by 12 mm., depth up to 10 mm.

Septa varying considerably in thickness, sloping or with their upper two-thirds vertical and narrower, those of adjacent corallites usually continuous over the inter-calicinal partitions, exsert to ·5 or 1 mm., septal edges and exsert ends well toothed, sides

spinulose, up to 55 in number, average about 40; of these 12—18 meeting columella, usually 15—17, each with up to 10 spinulose solid teeth, usually becoming longer towards columella. The subsidiary septa often curving towards and fusing with sides of principals near to columella, up to 3 or 4 on one side of a principal septum. An alternating cycle of very narrow septa present, continuous over inter-calicinal walls as in *F. vasta* (better seen over the walls than within the corallites) and alternating with exsert ends of the main septa. When the inter-calicinal walls are broad, the continuous exsert ends of both cycles are sometimes connected by an incomplete narrow ridge or appear grooved along the middle of the walls. Columella formed of septal trabeculæ, loosely spongy or closely twisted, rising into points, about $\frac{1}{4}$—$\frac{1}{3}$ width of calyx. Multiplication by marginal fission.

On level regions and especially towards edges the corallites are more regular in shape, hexa- or pentagonal, calices oval or circular but smaller in size, about 10 mm. in diameter and shallower (4 or 5 mm. in depth). The inter-calicinal walls are thickened to about 2·5 or 3 mm. and appear furrowed; the septa are also thickened, especially towards the walls, with the teeth reduced to 3 or 4 in number but swollen at their bases, the lowest ones becoming upright and simulating a pali-crown; the columellæ are formed of interlacing septal teeth. These regions of the corallum vary towards the *hirsuta* facies, but the corallites are much smaller and the corallum much less massive. Ehrenberg's type of *Favia complanata*, which is an edge-piece, has exactly the same appearance.

This species is variable to even a greater extent than *F. abdita*, all the stages from a light corallum with thin walls and septa to a heavy corallum with thick walls and septa being present. It resembles *F. abdita* in (1) having the same type of hillocky growth, with distorted corallites, (2) fission being marginal and very unequal, (3) up to 3 or 4 subsidiary septa fusing with one side of a principal septum; but differs from it in that the septa are further apart and less in number, the corallum more spiny and on the whole having a thicker facies.

The present species also approaches *F. vasta* (Klunz.) in that the two cycles of septa are continuous from corallite to corallite over the intervening walls, the consequent alternating appearance of large and small exsert ends being a characteristic feature of both; but in *F. vasta* the corallites are larger and the corallum is without the hillocky mode of growth.

Most of my specimens have the same facies as Ehrenberg's type (19 × 8 × 9 cm.) of *Astræa tesserifera*. In the Paris Museum are eleven good examples (the largest 30 × 23 cm.) from the Red Sea, referred by Milne Edwards and Haime to *Prionastræa tesserifera*, showing much of the variation possible in this species.

Locality. Red Sea (12). Not recorded from any other locality.

19. *Favia hemprichii* (Ehrenberg). (Pl. **27**, figs. 1, 2 and 4; **36**, fig. 3.)

1834. *Astræa hemprichii*, Ehrenberg, Corall. roth. Meer., p. 96.
? 1834. *Astræa dipsacea* (pars), Ehrenberg, Corall. roth. Meer., p. 97.
1851. *Prionastrea hemprichi*, Milne Edwards and Haime, Pol. foss. terr. palæoz., p. 102.
1857. *Prionastræa hemprichi*, Hist. Nat. Corall., ii, p. 521.
1879. *Prionastræa spinosa*, Klunzinger, Korall. Roth. Meer., iii, p. 39, pl. 4, fig. 7 and pl. 10, fig. 5.
? 1879. *Acanthastræa hirsuta* var. *microstoma*, Klunzinger, Korall. Roth. Meer., iii, p. 42, pl. 5, fig. 2.

1904. *Acanthastræa hirsuta* var. *microstoma*, Gardiner, Fauna and Geogr. Maldives and Laccadives, ii, p. 784, pl. lix, fig. 6.

Corallum. Usually incrusting, flat or convex, tending to become massive. Corallites hexa- or pentagonal, sometimes meandering (two or three corallites in a row being without intervening partitions). Inter-calicinal walls 1—5 mm. in thickness, average about 2·5 or 3 mm. Calices with average diameters 12 and 8 mm. (the longest meandering calyx being 25 mm.), depth 7 or 8 mm.

Septa usually sloping, swollen towards walls, those of adjacent corallites continuous over inter-calicinal walls, with conspicuously toothed edges, sides usually smooth, sometimes rough. Septa up to 45 in number, average about 35 ; of these 12—18 meeting columella, each with 6—8 smooth pointed teeth (hollow or solid), towards calicular opening usually becoming longer, obliquely directed and swollen at their bases, the first tooth (situated over the inter-calicinal wall) being longest (up to 3 mm.) and vertical and forming the most exsert part of each septum ; between two such rows of teeth the inter-calicinal partition appearing furrowed. Subsidiary septa often curving towards and fusing with sides of principal septa in groups of up to 3 or 4 as in *F. complanata*. Sometimes a few alternating rudimentary septa but the cycle never complete. Columella formed of interlacing septal teeth, often with points above, $\frac{1}{4}$—$\frac{1}{3}$ width of calyx.

Multiplication by unequal or equal fission, rarely by marginal fission.

I apply the name *Favia hemprichii* to this species with some hesitation, as Ehrenberg's type of *Astræa hemprichii* is a small incrusting specimen measuring 9·5 × 8·5 cm. (Pl. **36**, fig. 3). Judging only from the corallum, the grouping of my specimens under Ehrenberg's species appears to be the most satisfactory. Perhaps they resemble Klunzinger's type (8·5 × 7 × 4 × 4 cm.) of *Prionastræa spinosa* somewhat more than Ehrenberg's example, but the former is in no essential respect different from the latter ; it has polygonal corallites, well developed columellæ, conspicuous septal teeth which are longer and erect on the exsert septal ends, and its main septa are continuous over the walls.

This species is closely related to *F. complanata*, having more or less the same facies as the edge-regions of the latter, but differs from it in (1) the corallum being flat or convex, without the hillocky mode of growth so characteristic of *F. complanata*, (2) the corallites more uniform in shape and size, (3) fission sub-equal or equal, rarely marginal, (4) the general absence of smaller exsert ends alternating with those of the main septa, (3) the teeth being smooth and pointed and on the whole more conspicuous, increasing in length towards the calicular opening, hence the corallum appearing more thorny. The actual relationship of these two species can be settled only after a comparative study of their polyps.

Owing to the swollen nature of the septa in the theca and of the teeth, the species also resembles *F. hirsuta*. However the specimen, which Gardiner referred to *Acanthastræa hirsuta* var. *microstoma* (Klunz.) (Pl. **27**, fig. 4) appears to be more related to the present species than to var. *megalostoma*, its calices being much smaller than in the latter and of almost uniform size (diameters about 10 and 8·5 mm., depth 7 or 8 mm.), the inter-calicinal walls thinner (about 2·5 mm.) and the septa less in number (30—35). The specimen serves to show the degree of thickness possible in this species. The specimens

from Aldabra and Seychelles (Pl. **27,** figs. 1 and 2) constitute an intermediate series between Gardiner's example from Minikoi and the thin forms from Salomon. The latter specimens show some resemblance to *F. bertholleti* owing to the thinness of their walls and septa and the comparative shortness of their septal teeth ; hence their place in *F. hemprichii* is doubtful.

Of the five specimens in the Berlin Museum named *Astræa dipsacea*, Ehrb., four have been later referred to *Acanthastræa hirsuta* var. *microstoma* by Klunzinger—one, measuring 19 × 14 × 10 cm. is figured—and the fifth to var. *megalostoma*. The former, though possessing the thickened character of the latter, have smaller corallites and fewer septa ; I am therefore led to think that they, like the similarly named example of Gardiner's, form an extreme case of skeletal variation in the present species. Klunzinger's figured type of var. *megalostoma* is not in the Berlin Museum.

Milne Edwards and Haime's type of *Prionastræa hemprichi* is a small incrusting specimen (11 × 9 cm.) from the Red Sea; it undoubtedly is identical with both Ehrenberg's and Klunzinger's types. The spines on the exsert septal ends are even longer than in Klunzinger's example, the corallite-walls are ridged, 2—4 of the principal septa are thicker and broader, but to a less extent than in Gardiner's type of *Favia adduensis*, and the corallites have a tendency to meander as in my examples. In the Paris Museum there is also a large specimen from Koseir named *Prionastræa spinosa*.

Localities. Seychelles (5). Minikoi (1). Chagos, Salomon (5, thinner than the rest). Previously known only from the Red Sea.

20. *Favia favosa* (Ellis and Solander). (Pl. **28,** fig. 2.)

1786. *Madrepora favosa*, Ellis and Solander, Nat. Hist. Zooph., p. 167, pl. 50, fig. 1.
1797. *Madrepora favosa* (pars), Esper, Forts. Pflanz., p. 34, pl. 45A, fig. 1 (copy of Ellis and Solander's figure).
1830. *Dipsastrea favosa*, Blainville, Dict. Sci. Nat., lx, p. 338 ; Manuel d'actinol., p. 373.
1850. *Prionastrea magnistellata*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 129.
1850. *Prionastrea favosa*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 132.
1857. *Acanthastræa bowerbanki*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 503, pl. D 6, fig. 1.
1857. *Prionastræa magnistellata*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 516.
1857. *Prionastræa favosa*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 520.

I refer to this species a single massive convex specimen from Red Sea measuring 19 × 17 × 14·5 cm. which closely resembles Ellis and Solander's figure of *Madrepora favosa* (the type itself is missing from the Glasgow Museum). It has polygonal corallites, the calices of more or less uniform width along their entire height with diameters up to 20 and 14 mm. (average 18 and 13 mm.) and depth up to 11 or 12 mm. The intercalicinal walls are flat, being about 3 mm. The total number of septa vary up to 50 (average about 42) ; of these 16—18 septa meet the columella, their upper two-thirds being narrow and vertical while their lower thirds are broader and simulate a pali-crown. The septa have rough sides, short teeth (about 10) on their edges, and are exsert for 1 or 1·5 mm. The exsert ends are usually arched, those of neighbouring corallites either alternating or meeting, and are usually connected along the middle of the walls by a thin ridge. Owing to the arched condition of the exsert ends, the walls appear grooved above. The columella is formed by loosely interlacing septal trabeculæ and is $\frac{1}{4}$—$\frac{1}{3}$ the width of the calyx. New corallites are formed by unequal fission.

This specimen as well as Ellis and Solander's figure of *Madrepora favosa* have much the same facies as some of my examples of *Favia favus*, but possess, on the whole, larger corallites. Polyps are, however, necessary to determine if the specimen represents a good species or is only a large form of *F. favus*.

In the Paris Museum *Prionastræa favosa* and *magnistellata* are each represented by a large specimen and *Acanthastræa bowerbanki* by a very small one. I fail to see any differences separating these three species. They have, on the whole, larger corallites than my specimen, with the calices widest at the calicular openings and gradually narrowing towards their bases; moreover the inter-calicinal walls are ridged, the septa slope down towards the columellæ, those of neighbouring corallites meeting over the walls.

In the Glasgow Museum I have examined a specimen ($16{\cdot}5 \times 14 \times 9{\cdot}5$ cm.) which resembles Milne Edwards and Haime's *P. magnistellata* or *P. favosa* but it is doubtful if it is Ellis and Solander's figured type. Prof. Graham Kerr does not include it in his list* of specimens described by these authors.

According to Milne Edwards and Haime, *Madrepora favosa* (pars), Linnæus, is a rugose species *Stauria astreiformis* (*Cor.* iii, p, 325).

21. *Favia fragum* (Esper).

A single convex specimen ($7 \times 5{\cdot}5 \times 4{\cdot}5$ cm.) from St Vincent, collected by Mr C. Crossland. I hope soon to give a full account of this interesting species in the scientific Report of the British Antarctic Expedition based on material collected off South Trinidad. I have also seen examples of it in the Paris Museum.

22. ? *Favia parvimurata*, Gardiner.

1904. *Favia parvimurata*, Gardiner, Fauna Geogr. Maldive and Laccadives Archipel., ii, p. 771, pl. 62, fig. 25.

The only existing representative of this species is Gardiner's type ($11{\cdot}5 \times 10 \times 4$ cm.) from Hulule. The principal characters of this specimen are the penta- or hexagonal shape of the corallites, the thinness of the inter-calicinal walls, the last septal teeth being upright, high (1·5 mm.), broad and swollen at their bases, with their outer edges sloping away from their pointed tips and inner margins vertical. There is a conspicuous pali-crown; but towards the edge of the specimen the teeth are thin and short and hence the pali-crown is inconspicuous, the corallites approaching those of *Favia bertholleti* in appearance.

Somewhat resembling this specimen is Milne Edwards and Haime's type (small and flat) of *Favia bowerbanki* from Australia and a specimen (no. 3999) in the Berlin Museum from Ralum. A larger series of specimens is required in order to settle whether this is a true species.

23. *Favia* sp. ?

1899. *Astræa denticulata*, Gardiner, Proc. Zool. Soc. London, p. 748, pl. 47, fig. 1.
1899. *Astræa pallida*, Gardiner, Proc. Zool. Soc. London, p. 748.

* "Remarks upon the Zoological Collection of the University of Glasgow," *The Glasgow Naturalist*, vol. ii, no. 4, p. 111, 1910.

1899. *Astræa rotumana*, Gardiner, Proc. Zool. Soc. London, p. 750, pl. 47, fig. 3.
1899. *Astræa affinis*, Gardiner, Proc. Zool. Soc. London, p. 750.

The two large specimens (the larger measuring $19 \times 15 \times 9$ cm.) from Funafuti, which Gardiner referred to *Astræa denticulata* (Ell. and Sol.), the two small convex ones (the larger measuring $9 \times 7 \times 6$ cm.) from Rotuma, which he assigned to *Astræa pallida* (Dana), and the fragment from Wakaya named *Astræa affinis* (Ed. and H.) resemble one another so closely that there is hardly any doubt they belong to the same species. They do not agree with any of the type specimens I have examined. It is, however, likely that this species may have been previously recorded by Dana, but no satisfactory determination is possible from his descriptions or figures.

In all these specimens the corallum is massive and convex, the corallites are polygonal, often irregularly compressed, close together but usually separated by narrow grooves. Sometimes the walls are fused. The average diameters of the calices are 8—11 mm. and 6—8 mm. and the depth 5 or 6 mm. The septa are vertical, with rough sides and either toothed or entire edges, their total number varying from 25—35; of these 9—15 (average 11—13) meet the columella, their upper two-thirds being narrower than their lower one-third. At the calicular margins the principal septa are much broader (about 2 mm.) and thicker (·5 mm.) than the subsidiary septa and are more highly exsert (1·5—2 mm.). (This feature, as has been pointed out, is characteristic of many of Gardiner's Pacific specimens.) The exsert ends of the septa of neighbouring corallites either meet in notches or alternate. The columella is spongy, being formed of thin septal trabeculæ and is from $\frac{1}{4}$ to $\frac{1}{3}$ the width of the calices, sometimes quite rudimentary. New corallites are formed by equal or sub-equal fission, which is usually effected by two of the thickened principal septa meeting across the calices.

The small specimen ($10 \times 6 \times 4{\cdot}5$ cm.) from Rotuma, which Gardiner has made the type of a new species, *Astræa rotumana*, is closely related to the above-mentioned specimens but its corallum is lighter, the corallites somewhat further apart and the septa fewer. These differences are perhaps to be accounted for by the fact that the specimen was an edge-piece. It has also a general resemblance to my Salomon examples of *Favia clouei*.

24. *Favia* sp. ?

1899. *Prionastræa tenella*, Gardiner, Proc. Zool. Soc. London, p. 761.

A small convex specimen from Rotuma with an incrusting corallum 4·8 cm. long and 4·2 cm. broad, which Gardiner referred to *Prionastræa tenella*, Dana, appears to be a good species of *Favia*, being quite different from any other specimen I have examined. Its corallites are polygonal, the diameters of the calices measuring on an average 5 mm. and 4 mm. and depth 3 mm.; the inter-corallite walls are ridged, being about 1 mm. thick. The septa are sloping with uneven edges and rough sides, their total number varying from 20—26; alternating with these is a cycle of very narrow septa. 12—15 septa meet the columella, of which 6—8 are broader than the others, these giving the corallites a star-shaped appearance. All the septa are very slightly exsert, those of adjacent corallites meeting over the inter-corallite walls. The columella is thin and spongy. Fission is

equal or sub-equal. In the specimen there are seven double corallites of which two are *Cœloria*-like, being without partitions, while in the others the partitions have grown only up to the middle of the calices.

25. *Favia rotulosa* (Ellis and Solander).

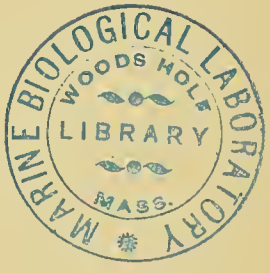
1786. *Madrepora rotulosa*, Ellis and Solander, Nat. Hist. Zooph., p. 166, pl. 55, figs. 1—3 (non *Astrea rotulosa*, Lamarck, and *Favia rotulosa*, Ehrb. and Ed. and H.).

There is no example of this species in my collections.

In Ellis and Solander's type ($12 \times 10 \times 9$ cm. and identical with their fig. 1) of *Madrepora rotulosa*, now in the Glasgow Museum, the corallites are round or oval, slightly projecting, becoming somewhat oblique towards the edges; the calices are 4—5 mm. in diameter. The total number of septa is up to 16 or 20, of which 6—8 meet the columella in every corallite, each with a conspicuous bluntly-pointed paliform lobe; an alternating cycle of rudimentary septa can be made out in some of the corallites.

Similar to this and of about the same size is another specimen in the Glasgow Museum, but as it is not one of Ellis and Solander's figured types its history cannot be determined.

In the Paris Museum are two large specimens named *Heliastræa annularis*, the larger ($26 \times 25 \times 16$ cm.) from "mers d'Amerique" and the other from West Indies, which are identical with Ellis and Solander's type.



GONIASTREA (Milne Edwards and Haime).

1816. *Astrea* (pars), Lamarck, Hist. Anim. sans vert., ii, p. 257.
1830. *Dipsastrea* (pars), Blainville, Dict. Sci. Nat., lx, p. 338.
1834. *Astrea* (pars), Ehrenberg, Corall. roth. Meer., p. 95.
1848. *Fissicelli* subgenus iii of *Astræa* (pars), Dana, Expl. exp. Zooph., p. 220.
1849. *Goniastræa* (pars), Milne Edwards and Haime, Compt. rend. de l'Acad. des Sci., xxvii, p. 495.
1857. *Goniastræa* (pars), Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 444.
1879. *Goniastræa* (pars), Klunzinger, Korall. Roth. Meer., iii, p. 32.
1884. *Goniastræa*, Duncan, Jour. Linn. Soc. London, Zool., xviii, p. 102.
1899. *Goniastræa*, Gardiner, Proc. Zool. Soc. London, p. 746.
1904. *Goniastræa*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 772.
1904. *Prionastræa* (pars), Gardiner, Fauna Geogr. Maldives and Laccadives, p. 785.

Corallum. Massive or incrusting. Corallites polygonal, often with a tendency to meander, walls completely fused, usually thin and ridged. Septa narrow, slightly exsert, all of more or less equal width at the calicular margin; when dipping vertically presenting an appearance of remarkably even-sized plates and making the walls appear thicker than they really are. The principal septa with paliform lobes; no true pali. An alternating cycle of rudimentary septa present. The main septa in neighbouring corallites either continuous over the walls or meeting the rudimentary ones, in the latter case appearing to alternate when seen with the naked eye. Columella little developed, sometimes quite absent.

Polyps. The following characters distinguish the polyps from those of *Favia*: (1) the presence of not more than six principal couples of mesenteries; (2) the number of subsidiary couples of mesenteries proportionately more than in *Favia*, viz. more than thrice (usually four or five times) the number of principal couples; (3) nematocysts II

modified into the II *c* type; usually arranged in rows in the coils of the mesenterial filaments; (4) nematocysts III, when present, narrower and longer than in *Favia*.

The polyps are polygonal, with no edge-zone. Both entocœlic and exocœlic tentacles are present, their number not always equalling that of the entocœles and exocœles, each with a swollen terminal battery; sub-terminal batteries present but number doubtful. The stomodæum is comparatively narrower than in *Favia*. The subsidiary couples of mesenteries vary considerably in their respective widths; their number in a primary exocœle also varies up to 5. The coils of the filaments are usually found protruded through the oral-disc. Fission of polyps equal or sub-equal.

The genus resembles *Favia* in many respects but the species studied form a homogeneous group. Until conclusive evidence is available for merging these genera, it is advisable to keep them separate.

Remarks. In the Berlin Museum there are two large specimens with irregular lobes, referred to *Scaphophyllia lobata*, Stud., their corallites showing a pronounced meandering facies. There is little doubt that these specimens belong to *Goniastrea*, the corallites on the humps having thin septa and resembling those of *G. pectinata* (Ehrb.), while those towards the edges are shallower with conspicuous paliform lobes simulating the condition in *G. planulata*, Ed. and H. The irregular mode of growth of the corallum is, however, a striking difference from both *G. pectinata* and *G. planulata*. I did not examine the type-specimen of *Scapophyllia cylindrica*, Ed. and H., in the Paris Museum, not realising at the time the probable relationship of that genus to *Goniastrea*. If, on examination of polyps, the identity of the two genera should be established, *Scapophyllia* would, in accordance with the claims of priority, have to replace *Goniastrea*. The three specimens on which Quelch instituted his new species *G. multilobata* (figured specimen 13 cm. long and 12 cm. high) resemble in every respect the Berlin examples of *Scaphophyllia lobata*, Stud.; the hillocks in these specimens sometimes end in ridges as in *Favia abdita* (Ell. and Sol.).

The following is a list of specimens originally assigned to *Goniastrea* by various authors but which really belong to *Favia*:

No of specimens	Size of specimens	Locality	Species originally referred to	By whom	Probable place in *Favia*
1	large, convex	Unknown	*G. rudis*, Ed. and H.	Milne Edwards and Haime	*F. pentagona* (Esp.)
1	18 × 10 × 4 cm.	Red Sea	*G. halicora* (Ehrb.) var. *obtusa*	Klunzinger	*F. bertholleti*, Ed. & H.
1	25 × 21 × 16 cm.	,,	*G. halicora* (Ehrb.) var. *acuta* (= *Astræa halicora* Ehrb.)	,,	*F. halicora* (Erhb.)
1	8·5 × 7·5 × 3·5 cm.	,,	*G. seychellensis*, Klunz. (= *Astræa deformis*, Ehrb.)	,,	? *F. favus* (Forsk.)
1	Corallum incrusting 5·5 × 5 cm.	Api, New Hebrides	*G. laxa*, Quelch	Quelch	*F. pentagona* (Esp.)
1	A fragment	Banda	*G. favistella* (Dana)	,,	*F. abdita* (Ell. & Sol.)
1	23 × 18 × 17 cm.	Ceylon	*G. serrata*, Ortm.	Ortmann	*F. doreyensis* (Oken)
1	6 × 4·5 × 2·5 cm.	Suvadiva	? *G. favus* (Forsk.)	Gardiner	*F. pentagona* (Esp.)

In the Hofmuseum, Vienna, are eight large specimens ("Pola" expedition), referred by Marenzeller to *G. halicora* (Ehrb.). Without polyps it is difficult to decide if they belong to *Goniastrea* or *Favia*. No. 15961 ($20 \times 19 \times 16$ cm.) resembles Klunzinger's example of *G. seychellensis*; the corallites on its side are circular or oval, shallow and wider apart with peritheca between. Nos. 15928 and 15933 are somewhat similar to Milne Edwards and Haime's example of *Prionastræa profundicella* (perhaps a *Goniastrea*), while No. 15929 agrees with these authors' type-specimens of *Favia denticulata* [= *F. favus* (Forsk.)]. No. 15934 is the largest specimen, measuring $35 \times 35 \times 16$ cm., with also the largest corallites.

Distribution. Indian and Pacific Oceans. Cretaceous to recent (Eastman after Zittel).

1. *Goniastrea solida* (Milne Edwards and Haime). (Pl. **10**, fig. 1; **28**, figs. 3 and 4; **31**, fig. 1; **33**, fig. 4; **38**, fig. 3.)

1830. *Dipsastrea solida*, Blainville, Dict. Sci. Nat., lx, p. 338; Manuel d'Actinol., p. 373.
1850. *Goniastrea solida* (pars), Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 160 (non *Madrepora solida*, Forsk.).
1857. *Goniastræa solida* (pars), Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 444.
1879. *Goniastræa favus* (pars), Klunzinger, Korall. Roth. Meer., iii, p. 35 (non *Madrepora favus*, Forsk.)
1904. *Goniastræa solida*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 772, pl. 62, fig. 28.

Corallum. Massive, convex. Corallites never meandering. Inter-calicinal walls 1 or 1·5 mm. thick, sometimes rounded. Calices about 4 mm. in diameter, up to 4 mm. deep, usually 3 or 3·5 mm., shallower towards the edges.

Septa slightly sloping or vertical, edges serrate, with sides spinulose, up to 32 in number, average 25—30, usually meeting the rudimentary septa of neighbouring corallites. 8—11 septa meeting in the centre; sometimes the pali-crown represented by the lower thickened parts of their inner edges. Columella more or less compact, short, $\frac{1}{4}$—$\frac{1}{5}$ width of calyx.

Polyps. (1) In the stomodæal region of polyp, subsidiary couples of mesenteries, about four or five times the number of principal couples. (2) In same region of polyp, entocœlic pleats usually absent from principal mesenteries, when present very narrow and not extending to outer one-third of width of mesentery; pleatal region thickened. (3) Nematocysts II *b* somewhat more numerous in the terminal tentacular batteries than type I. (4) Nematocysts II *c* with the dark-stained axis about $\frac{1}{4}$ length of sac.

Remarks. A. *Polyps.* In the polyps examined, 5 or 6 principal couples of mesenteries are present, of which 1 couple is incomplete, and 21—26 subsidiary couples, the latter varying greatly in their width. Entocœlic pleats make their appearance below the stomodæal region of polyp but are short, thick and blunt. The convolutions of mesenteries are abundant below the stomodæum, also protruded through the oral-disc. The stomodæum is oval in transverse section, its diameters being about 1·25 mm. and ·75 mm.; its ridges are thicker than broad, with crowded nuclei, and with some nematocysts I occurring in their lower halves. The ectoderm of the oral-disc is thin, resembling that of *Cyphastrea*. The nematocysts I in the terminal batteries of the tentacles have

25—30 turns of the spiral in each. Filaments are present on all the principal mesenteries and the wider subsidiaries; nematocysts I occur in small numbers along their whole lengths; II *c* nematocysts are numerous, as closely arranged in the convolutions as III *b* in *Echinopora*. Type III is absent. The endoderm in the oral-disc is as thin as the ectoderm over it, in the tentacles vacuolated and lobed with numerous algæ, in the mesenteries somewhat swollen on each side of the thickened region of the mesoglæa, beyond which it is thin. Algæ are scarce in the mesenterial endoderm. Gonads were not present in any of the polyps. The polyps of this species bear greater resemblance to those of *G. pectinata* than to those of *G. retiformis*, although the condition is reversed with regard to the corallum.

Number of polyps examined three, from a specimen from Amirante, 16 fms.

B. *Corallum.* Klunzinger's suggestion that *Madrepora solida*, Forsk. was a *Porites* has later been confirmed by Marenzeller's examination of Forskål's type-specimens in the Copenhagen Museum. Marenzeller has also made the discovery that *Madrepora favus*, Forsk., is not a *Goniastrea*. Of the two specific names I have retained the former since it comes first in Forskål's paper. I could not examine Klunzinger's type-specimen of *G. favus*, as it was not in the Berlin Museum, but judging from his figure it appears to belong to the present species. Of the five specimens referred by Milne Edwards and Haime to *G. solida* (2 from Red Sea and 3 from Seychelles) two (one from each locality) belong to *G. retiformis*, the figured specimen (*Ann. Sci. Nat.*, 3e sér, x, pl. 9, fig. 7) being one of them; all these specimens were later re-named *G. favus* by Klunzinger.

In the Hofmuseum, Vienna, are 19 specimens ("Pola" expedition) referred to *G. favus* by Marenzeller, of which 12 are numbered; of these nos. 15919, 15921, 15922 and all the unnumbered specimens are undoubtedly *G. retiformis*. The remaining ones may be assigned to *G. solida*; no. 15918 has corallites showing a meandering tendency.

Localities. Seychelles (1). Maldives, Hulule (1). Amirante (1 small, 16 fms.). Known also from the Red Sea (Milne Edwards and Haime, and Marenzeller).

2. *Goniastrea retiformis* (Lamarck). (Pl. **10**, fig. 3; **31**, figs. 1—5; **33**, fig. 3; **38**, figs. 2 and 4.)

1816. *Astrea retiformis*, Lamarck, Hist. Anim. sans vert., ii, p. 265; 2e édit., p. 415.
1834. *Astrea spongia*, Ehrenberg, Corall. roth. Meer., p. 96.
1850. *Goniastrea solida* (pars), Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 160.
1850. *Goniastrea retiformis*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 161.
1850. *Goniastrea bournoni*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 162.
1857. *Goniastræa solida* (pars), Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 444.
1857. *Goniastræa retiformis*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 446.
1857. *Goniastræa bournoni*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 446.
1879. *Goniastræa retiformis*, Klunzinger, Korall. Roth. Meer., iii, p. 36, pl. 4, fig. 5.
1889. *Goniastræa retiformis*, Ortmann, Zool. Jahrb., iv, p. 527.
? 1879. *Goniastræa favus* (pars), Klunzinger, Korall. Roth. Meer., iii, p. 35, pl. 4, fig. 4 and pl. 10, fig. 7 (non *Madrepora favus*, Forsk.).
1892. *Goniastræa retiformis*, Ortmann, Zool. Jahrb., vi, p. 661.
1899. *Goniastræa eximia*, Gardiner, Proc. Zool. Soc. London, p. 747.
1899. *Goniastræa solida*, Gardiner, Proc. Zool. Soc. London, p. 747.
1904. *Goniastræa retiformis*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 772.

Corallum. Massive, convex. Corallites penta- or hexagonal, often drawn out for fission. Inter-calicinal walls thinner than in *G. solida*, never more than ·75 mm. Calices about 4 mm. in diameter, depth 2—3 mm.

Septa sloping gradually to a short distance, then dipping vertically; edges serrate, sides rough; total number 18—22, usually meeting the rudimentary septa in neighbouring corallites; 7—11 septa meeting columella. Clefts behind paliform lobes sometimes extending below level of columella. Columella spongy or dense, $\frac{1}{5}$—$\frac{1}{4}$ width of calyx, sometimes quite rudimentary.

Polyps. (1) In the stomodæal region of polyp, subsidiary couples of mesenteries about three or four times the number of principal couples. (2) In the same region, entocœlic pleats narrow, slightly constricted at their bases, occasionally sub-divided and restricted to outer one-third of width of principal mesentery; pleatal region thicker than in *G. solida*. (3) Nematocysts II *b* much fewer in the terminal tentacular batteries than in *G. solida*. (4) Nematocysts II *c* with the dark-stained axis in each about three-fifths length of the sac.

Polyps examined 14, 3 and 2 from two specimens from Hulule, Maldives, 2 from a Ceylon colony, and 7 from five Rotuma colonies.

Remarks. A. *Polyps.* 5 or 6 principal couples of mesenteries are present, of which 1—3 are incomplete, and as many subsidiary couples as in *G. solida*. The pleatal region of the mesenterial mesoglæa, when compared with the very thin non-pleatal region is much thicker than in any species studied; below the stomodæal region of polyp, the entocœlic pleats become broader and sub divided and extend over the outer half or two-thirds of the width of the mesentery. The convolutions of the mesenteries are scarce, hence the inter-mesenteric chambers appear more or less empty. 5 or 6 sub-terminal batteries are present on the tentacles. The stomodæum is narrower than in *G. solida*, its diameters being ·75 mm. and ·65 mm. Its ridges are thicker than broad, and tend to unite in the upper half of the stomodæum, two belonging to mesenteries of adjacent couples forming each compound ridge. Nematocysts I and III rarely occur in the ridges. Nematocysts I and II *c* are found occasionally in the straight regions of the mesenterial filaments, while in their convolutions types II *c* and III occur in large numbers, the axis of the former being somewhat bent into a drawn out S. The calicoblastic layer of ectoderm is vacuolated and deeply columnar near the skeletal attachments of the mesenteries. The endoderm is vacuolated everywhere; in the oral-disc it is thicker than the overlying ectoderm, resembling that of *Favia pentagona* in that the algæ are not closely arranged and the nuclei gathered along its peripheral region; on the mesenteries the endoderm is very thin on either side of the non-pleatal region, swollen in the pleatal region where the vacuoles are arranged in the form of a row of oval sacs on either side, conspicuously swollen (pad-like in transverse section) behind the filaments. Gonads were not present in any of the polyps.

B. *Corallum.* In Lamarck's collection in the Paris Museum is a small specimen named *Astræa retiformis*, Lam., on which apparently Lamarck founded his species. A small specimen from the Red Sea, which Milne Edwards and Haime assigned to *Heliastræa acropora*, and which was later referred to *G. favus* by Klunzinger, resembles

G. retiformis more than any other species, but has somewhat larger calices. Milne Edwards and Haime's examples of *G. bournoni* and *G. retiformis* number respectively five (locality unknown) and two (large, from Seychelles). Ehrenberg's type-specimen of *Astræa spongia* (later referred by Klunzinger to *G. retiformis*) is a large example measuring 20 × 15 × 11 cm. In the Hofmuseum, Vienna, are two fine specimens ("Pola" expedition), referred to *G. retiformis* by Marenzeller. Quelch has referred a large specimen from Kandavu, Fiji, to *G. cerium* (Dana); it is identical with *G. retiformis*.

Localities. Maldives: Hulule (8); Goidu (2). Minikoi (4). Seychelles (13). Red Sea (5). Aldabra (2). Rotuma (4). Ceylon (small specimens). Singapore (1). Also from Fiji (Quelch) and Dar-es-Salaam (Ortmann). A common species in the Indo-Pacific Ocean.

3. *Goniastrea pectinata* (Ehrenberg). (Pl. **28**, fig. 6; **37**, fig. 1.)

1834. *Astræa pectinata*, Ehrenberg, Corall. roth. Meer., p. 96.
1850. *Goniastrea solida* (pars), Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 160.
1850. *Goniastrea quoyi*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 162.
1850. *Goniastrea grayi*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 163.
1857. *Goniastrea solida* (pars), Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 444.
1857. *Goniastrea quoyi*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 447.
1857. *Goniastrea grayi*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 447.
1879. *Goniastræa pectinata*, Klunzinger, Korall. Roth. Meer., iii, p. 34, pl. 4, fig. 6 (non *Goniastræa pectinata*, Gardiner).
1886. *Goniastræa coronalis*, Quelch, Reef Corals, Challenger Reports, vol. xvi, part xlvi, p. 101, pl. 3, figs 3—3*a*.
1907. *Goniastrea pectinata*, Vaughan, Proc. U.S. Nat. Mus. Washington, xxxii, p. 257.

Corallum. Incrusting, raised into rounded humps. Corallites irregular with a tendency to meander. Inter-calicinal walls thin. Single calices larger than in the previous two species, average size 7 × 6 mm.—the longest meandering calyx without any sign of fission 16 mm.—depth about 7 mm.

Septa vertical, of equal width at calicular margin (1—1·25 mm.), here appearing as one series, edges serrate, sides with blunt spinules, up to 30, average about 25; septa continuous in arches over walls of neighbouring corallites, perhaps meeting rudimentary septa; 10—15 septa (average 12) approaching centre of corallite, each with a blunt paliform lobe. Columella quite rudimentary or absent.

Towards edges calices are shallower, septa and inter-calicinal walls thicker, the latter up to 3 mm.

Polyps. (1) In the stomodæal region of polyp, subsidiary couples of mesenteries about four or five times the number of principal couples. (2) In the same region, entocœlic pleats when present very narrow and blunt, and not extending beyond outer half of principal mesenteries, usually over outer one-third, sometimes absent; pleatal region thickened. (3) Nematocysts II *b* few in the terminal tentacular batteries as in *G. retiformis*. (4) Nematocysts II *c* resembling those of *G. solida*, each with its dark-stained axis not more than one-third length of sac.

Three polyps sectioned from a specimen from Donganab, Red Sea.

Remarks. A. *Polyps.* As in *G. solida* the convolutions of the mesenteries are abundant below the stomodæum and also protruded through the oral-disc. The stomodæum is somewhat wider than in *G. solida*, its diameters being 1·5 and 1 mm.; its

ridges are thicker than broad with nematocysts I present in their lower halves, these occurring also in the mesenterial filaments. Nematocysts II *c* are arranged close together as in *G. solida*. Nematocysts III are absent. The endoderm is somewhat swollen on either side of the thickened region of the mesenterial mesoglæa, with few algæ.

In one of the polyps sectioned two stomodæa are present with six couples of mesenteries attached to each. The appearance suggests that one has been formed as an upward diverticulum from the base of the other, since the former opens into the latter and some of the original principal mesenteries are still found passing from one to the other. This polyp recalls some of the figures which Duerden has given of transverse sections of polyps of West Indian *Acropora* (Madrepora; **33**, figs. 4, 5 and 7), but he interprets those appearances on the hypothesis of stomodæal fission.

B. *Corallum.* Ehrenberg's specimen of *Astræa pectinata* (= *G. pectinata*, Klunz.) in the Berlin Museum measures 8·5 × 6 × 5·5 cm., but has somewhat narrower corallites than my examples. In the Paris Museum *G. quoyi*, Ed. and H., is represented by a specimen from Tongatabou, measuring 11 × 11 × 7 cm., and *G. grayi*, Ed. and H., by a smaller example from Australasia. Klunzinger has rightly referred two of Milne Edwards and Haime's specimens to *G. pectinata*, one from Red Sea originally assigned to *G. solida* and another without locality to *Prionastræa seychellensis*, Ed. and H. In the Hof-museum, Vienna, are two fine specimens collected by the "Pola" exhibition, one from Idda and the other (larger, 17 × 11 × 14 cm.), from Bernice, referred by Marenzeller to *G. pectinata*.

Quelch's new species *G. coronalis* is founded on a small, thin, somewhat convex edge-piece from Banda, measuring 8 × 8 cm.; it is, in all probability, the same as *G. pectinata*, the only differences being that the columellæ are somewhat better developed and the paliform lobes broader. The two specimens (one, large, from Somerset, Cape York, the other, small, from Banda), referred by Quelch to *G. quoyi*, differ from Milne Edwards and Haime's examples of the same species in that (1) the columellæ are composed of closely-twisted trabeculæ, and (2) the septa are somewhat sloping, very narrow at the calicular margins, about 18 meeting columella. The two small specimens from Mactan Island, Philippines, which the same author has referred to *G. grayi*, resemble his specimens of *G. quoyi*, but have slightly larger and deeper calices.

Localities. Red Sea (4). Chagos, Salomon (1). Also from Tongatabou and Australasia (Milne Edwards and Haime), ? Banda (Quelch), French Somaliland (Vaughan).

4. *Goniastrea planulata*, Milne Edwards and Haime. (Pl. **28**, fig. 5; **31**, figs. 7 and 8.)

1850. *Goniastrea planulata*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., xii, p. 162.
1857. *Goniastræa planulata*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 447.
1904. *Goniastræa pectinata*, Gardiner, Fauna Geogr. Maldives and Laccadives, p. 773.

Corallum. Incrusting, becoming massive. Corallites with tendency to meander as in *G. pectinata*. Inter-calicinal walls thicker, up to 3 mm., usually about 1·5 mm., ridged. Single calices somewhat smaller, 5—6 × 4 mm. (the longest meandering calyx without any mark of fission 11 mm.), depth about 5 mm.

Septa vertical, of equal width at calicular margins, but thicker and arranged closer

together than in *G. pectinata*, edges serrate, sides with crowded pointed spinules, total number 22—29, usually continuous from corallite to corallite; 9—11 septa meeting columella, with conspicuous paliform lobes (·75—1 mm. broad). Columella somewhat better developed than in *G. pectinata*.

Towards edges calices shallower, but septa and inter-calicinal walls thinner.

A thicker and rougher species than *G. pectinata*, but polyps necessary for determining whether it is different from the latter or not*. Milne Edwards and Haime's type of *G. planulata* (locality unknown) is 13 cm. long and 10 cm. broad, with incrusting corallum, but somewhat shallower calices than in my specimens (Pl. **31**, fig. 7).

Localities. Maldives: (1 dredged); Goidu (1); Turadu (1). Chagos: Salomon (3); Egmont (2). Red Sea (1). Not recorded from the Pacific Ocean.

ADDENDA. SOME TYPE SPECIMENS.

Astræa deformis, Ehrb., Corall., p. 96 (non *Astrea deformis*, Lam.).

Prionastræa seychellensis, Ed. and H., Corall. ii, p. 517.

I have examined Ehrenberg's large type of *Astræa deformis* and Milne Edwards and Haime's two large examples of *Prionastræa seychellensis*†, and have no doubt that they belong to the same species. There is also a large series of this species from different localities in my collections showing a wide and interesting range of skeletal variation. I hope to receive polyps of this important species in a short time, when a full account of its hard and soft parts will be given. At present it cannot be settled whether the species is a *Favia* or *Goniastrea*—probably the latter.

?*APHRASTREA* (Milne Edwards and Haime).

?*APHRASTRÆA DEFORMIS* (Lamarck).

1816. *Astrea deformis*, Lamarck, Hist. Anim. sans vert., ii, p. 264; 2e édit., p. 414.
1830. *Dipsastrea deformis*, Blainville, Dict. Sci. Nat., lx, p. 338; Manuel d'Actinol., p. 273.
1849. *Aphrastrea deformis*, Milne Edwards and Haime, Ann. Sci. Nat., Zool., 3e sér., x, pl. 9, fig. 11, and 12, p. 165.
1857. *Aphrastræa deformis*, Milne Edwards and Haime, Hist. Nat. Corall., ii, p. 452.
1904. *Aphrastræa deformis*, Gardiner, Fauna Geogr. Maldives and Laccadives, ii, p. 773, pl. 63, fig. 31.

The four specimens from the Maldives, referred by Gardiner to *Aphrastræa deformis* (Lam.), are identical with Milne Edwards and Haime's figure of the species, the type being missing from the Paris Museum. No polyps of this species were available for examination, but from the appearance of the corallites it may well be presumed that the species does not possess the bilateral symmetry characteristic of Group I. The question whether it constitutes a separate genus or is to be placed in the genus *Favia* can be settled only after a study of its polyps.

The principal characters of Gardiner's specimens are as follows: Corallum more or less flat. Corallites penta- or hexagonal, more or less uniform in size. Inter-calicinal walls, much thickened, up to 5 or 6 mm., average 3 mm.; this thickness due to secondary deposition of calcareous material in the form of vesicles within the corallites† filling up

* Three sectioned polyps of this species from a specimen from Maldives were useless for histological purposes.

† The intra-corallite deposition of calcareous matter is very evident in transverse sections of the corallum and is much more than the inter-corallite deposit (*i.e.* peritheca). The significance of this phenomenon can be determined only after examining the polyps.

the spaces between the septal synapticulæ and the wall (Milne Edwards and Haime's "endotheca"); thin low ridges present along middle of inter-calicinal walls, presumably marking the position of the original thecæ and therefore the true boundaries of the corallites. Calices usually circular, 4—5 mm. in diameter, depth 2 or 2·5 mm., with tendency to get filled in.

Septa thin, appearing narrow within calices (owing to their outer regions being buried in the intra-corallite calcareous deposit), slightly exsert (not more than ·5 mm.), with slightly rough sides, toothed vertical edges; septa 30—36 in number, about 11—13 meeting columella, each with a conspicuous cylindrical blunt paliform lobe 1·5 mm. high (behind which septum perforated) and about 4 teeth. Only the exsert ends of about half the number of subsidiary septa visible. Septa of adjacent corallites either meeting over walls or alternating, connected along middle of walls by thin ridges. Columella closely spongy, $\frac{1}{4}$—$\frac{1}{3}$ width of calyx, formed of septal trabeculæ, sometimes rising into rough points.

Multiplication by fission.

Vaughan records a specimen of this species from French Somaliland, but gives no figure.

V. LITERATURE RELATING TO POLYP ANATOMY.

1. Ashworth, J. H. "The Stomodæum, Mesenterial Filaments and Endoderm of *Xenia*." Proc. Roy. Soc. London, lxiii, p. 443, 1898.
2. Id. "The Structure of *Xenia hicksoni*, nov. sp., with some Observations on *Heteroxenia elizabethæ*, Köllicker." Quart. Jour. Micr. Sci., xlii, p. 245, 1899.
3. Awerinzew, S. "Studien über parasitische Protozoen." Trav. Soc. Naturlistes St Pétersbourg, Bd. 38, Lief 2, S. 1—139, T. 1—3, 1908.
4. Bedot, M. "Recherches sur les cellules utricanthes, I Vélellides, Physalides." Rec. Zool. Suisse, vol. 4, p. 51, 1886.
5. Id. "Note sur les Cellules utricanthes." Rev. Suisse Zool., vol. 3, p. 533, 1896.
6. Beneden, Édouard van. "Une Larve voisine de la Larve de Semper." Archiv. de Biologie, x, p. 485, 1890.
7. Id. "Recherches sur le développement des Arachnactis, Contributions à la Morphologie de Cerianthides." Archiv. de Biologie, xi, p. 115, 1891; and Bull. Acad. r. s. Belgique, 3e sér., xxi, p. 179, 1891.
8. Id. "Les Anthozoaires de la Plankton-Expedition." Resultats de la Plankton-Expedition der Humboldt-Stiftung, ii, k. e., 1897.
9. Boulenger, Charles L. "On *Moerisia lyonsi*: a new Hydromedusan from Lake Qurun." Quart. Jour. Micr. Sci., lii, p. 357, 1908.
10. Id. "On the Origin and Migration of the stinging cells in Craspedote Medusæ." Quart. Journ. Micr. Sci., vol. lv, p. 763, 1910.
11. Bourne, G. C. "The Anatomy of the Madreporarian Coral *Fungia*." Quart. Jour. Micr. Sci., xxvii, p. 293, 1887.
12. Id. "The Anatomy of *Mussa* and *Euphyllia* and the Morphology of the Madreporarian Skeleton." Quart. Jour. Micr. Sci., xxviii., p. 21, 1888.
13. Id. "On the Postembryonic Development of *Fungia*." Trans. Roy. Dublin Soc., v (series ii), iv, p. 205, 1893.
14. Id. "A criticism of the Cell-Theory; being an Answer to Mr Sedgwick's Article on the Inadequacy of the Cellular Theory of Development." Quart. Jour. Micr. Sci., xxxviii, p. 137, 1895.
15. Id. "Studies on the Structure and Formation of the Calcareous Skeleton of the Anthozoa." Quart. Jour. Micr. Sci., xli, p. 499, 1899.
16. Id. "The Anthozoa." A Treatise on Zoology, edited by E. Ray Lankester, Part ii, chap. vi, 1900.
17. Id. "On the Solitary Corals." Ceylon Pearl Oyster Fisheries, Suppl. Report, No. xxix, p. 187, 1905.
18. Boveri, Th. von. "Ueber Entwicklung und Verwandtschaftsbezeichungen der Aktinien." Zeits. Wiss. Zool., xlix, p. 461, 1889.
19. Id. "Das Genus *Gyractis*." Zool. Jahrb., vii, p. 241, 1893.
20. Carlgren, Oskar. "Studien über Nordische Actinien." Kongl. Svenska Vetenskaps-Akademiens Handlingar, Stockholm, Bd. 25, No. 10, 1893.

21 Carlgren, Oskar. "Ostafrikanische Actinien. Gesammelt von Herrn Dr F. Stuhlmann 1888 und 1889." Mitt. Nat. Mus. Hamburg, xvii, 1900.

22. Id. "Beobachtungen über die Mesenterienstellung der Zoantherien nebst Bemerkungen über die bilaterale symmetrie der Anthozoen." Festskrift för Lilljeborg, Upsala, p. 149, 1896.

23. Id. "Zur Mesenterienentwickelung der Actinien." Ofv. k. vet. Akad. Föhr., Stockholm, vol. 54, p. 159, 1897.

24. Cerfontaine, Paul. "Notes préliminaires sur l'organisation et la développement de differentes formes d'Anthozoaires." Bull. Acad. r. s. Belgique, 3e sér., xxi, p. 29. 1891.

25. Id. "Notes préliminaires sur l'organisation et le développement de différentes formes de Anthozoaires." Bull. Acad. r. s. Belgique, 3e sér., xxii, p. 128, 1891.

26. Delage, Y. et E. Hérouard. "Les Cœlentérés." Traité de Zoologie Concrète, ii, 2, 1901.

27. Dixon, F. "On the Arrangement of the Mesenteries in the Genus *Sagartia*, Gosse." Sci. Proc. Roy. Dublin Soc., N.S., vi, p. 136, 1888.

28. Dixon, G. Y. "Remarks on *Sagartia venusta* and *Sagartia nivea*." Sci. Proc. Roy. Dublin Soc., N.S., vi, p. 111, 1888.

29. Dixon, G. Y. and A. F. "Notes on *Bunodes thallia, Bunodes verrucosa* and *Tealia crassicornis*." Sci. Proc. Roy. Dublin Soc., N.S., vi. p. 310, 1889.

30. Id. "Report on the Marine Invertebrate Fauna near Dublin." Proc. Roy. Irish Acad., 3rd ser., ii, p. 19, 1891.

31. Duerden, J. E. "On the Relations of Certain Stichodactylinæ to the Madreporaria." Jour. Linn. Soc. Zool., xxvi, p. 635, 1898.

32. Id. "West Indian Madreporarian Polyps." Nat. Acad. Sci. U.S.A., viii, p. 403, 1902.

Id. "The Morphology of the Madreporaria."

33. ii. "Increase of Mesenteries in Madreporaria beyond the Protocnemic stage." Johns Hopkins University Circulars, xxi, No. 157, p. 59, 1902; and Ann. Mag. Nat. Hist., ser. 7, x, p. 96, 1902.

34. iii. "The significance of Budding and Fission." Ann. Mag. Nat. Hist., ser. 7, x, p. 382, 1902.

35. iv. "Fissiparous Gemmation." Ann. Mag. Nat. Hist., ser. 7, xi, p. 141, 1903.

36. v. "Septal Sequence." Biol. Bull., vii, No. 2, p. 79, 1904.

37. Id. "The Coral *Siderastrea radians* and its Postlarval Development." Carnegie Institution, Washington, 1904.

38. Duncan, P. Martin. "On some Thallophytes parasitic within recent Madreporaria." Proc. Roy. Soc., xxv, p. 238, 1876—1877.

39. Erdmann, August. "Ueber einige neue Zoantheen." Jenaische Zeitsch. Naturwiss., xix, p. 489, 1886.

40. Faurot, L. "Études sur l'Anatomie, l'Histologie et le Développement des Actinies." Archiv. de Zool. Exp. et Gen., 3e sér., iii, p. 43, 1895.

41. Id. "Scyphozoaires—L'Actinie." Zoologie Descriptive, edited by Louis Boutan, vol. i. chap. viii, 1900.

42. Id. "Développement du Pharynx des Couples et de Paires de Cloisons chez les Hexactinies." Archiv. de Zool. Exp. et Gen., 4e sér., i, p. 359, 1903.

43. Id. "Nouvelles Recherches sur le Développement du Pharynx et des Cloisons chez les Hexactinies." Archiv. de Zool. Exp. et Gen., 4e sér., vi., p. 333, 1907.

Fowler, G. H. "The Anatomy of the Madreporaria."

44. i. "*Flabellum, Rhodopsammia.*" Quart. Jour. Micr. Sci., xxv, p. 577, 1884; and Stud. Owens Coll., i., p. 243, 1886.

45. ii. "*Madrepora.*" Quart. Jour. Micr. Sci., xxvii, p. 1, 1887; and Stud. Owens Coll., ii, p. 1, 1890.

46. iii. "*Turbinaria, Lophohelia, Seriatopora, Pocillopora.*" Quart. Jour. Micr. Sci., xxviii, p. 1, 1888; and Stud. Owens Coll., ii. p. 17, 1890.

47. iv. "*Madracis, Amphihelia, Stephanophyllia.*" Quart. Jour. Micr. Sci., xxviii, p. 413, 1888.

48. v. "*Duncania, Madrepora, Galaxea, Heteropsammia, Bathyactis.*" Quart. Jour. Micr. Sci., xxx, p. 405, 1890.

49. Gardiner, J. Stanley. "On the Anatomy of a supposed new species of *Cœnopsammia* from Lifu." Willey Zool. Results, Part iv, p. 357, 1899.

50. Id. "South African Corals of the Genus *Flabellum*, with an account of their anatomy and development." Marine Invest. South Africa, ii, p. 117, 1902.

51. Id. "Some Notes on Variation and Protandry in *Flabellum rubrum*, and Senescence in the same and other corals." Proc. Camb. Phil. Soc., xi, Pt. iv, p. 463, 1902.

52. Id. "The Turbinolid Corals of South Africa, with notes on their Anatomy and Variation." Marine Invest. South Africa, iii, p. 95, 1904.

53. Gosse, P. H. "Actinologia Britannica: A History of the British Sea Anemones and Corals," London, 1860.

54. Haacke, W. "Zur Blastologie der Korallen." Jenaische Zeitschrift, xiii, p. 269, 1879.

55. Haddon, A. C. "A Revision of the British Actiniæ, Part i." Trans. Roy. Dublin Soc., iv (Series ii), v, p. 297, 1889.

56. Id. "A Newly-Hatched Larva of *Euphyllia.*" Proc. Roy. Dublin Soc., vii, Part iii, xiv, p. 127, 1890.

57. Haddon, A. C., and Shackleton, Alice M. "A Revision of the British Actiniæ, Part ii." Trans. Roy. Dublin Soc., iv (Series ii). xii, p. 609, 1891.

58. Id. "Reports on the Zoological Collections made in Torres Straits." Trans. Roy. Dublin Soc., iv (Series ii), xiii, p. 673, 1891.

59. Hadži, J. "Über die Nesselzellwanderung bei den Hydroidpolypen." Arb. Zool. Inst. Wien, xvii, 1907.

60. Id. "Die Entstehung der Knospe bei Hydra." Arb. Zool. Inst. Wien, xviii, 1910.

61. Havet, J. "Contribution a l'étude du Système nerveux des Actinies." La Cellule, xviii, fasc. 2, p. 387, 1901.

62. Heider, A. R. von. "*Sagartia troglodytes*—Ein Beitrag zur Anatomie der Actinien." Sitzb. kais. Acad. Wien, lxxv, Abth. 1, p. 367, 1877.

63. Id. "Die Gattung *Cladocora* Ehrb." Sitzb. Akad. Wissensch. Wien, lxxxiv, p. 634, 1881.

64. Id. "Korallenstudien: *Astroides calycularis* u. *Dendrophyllia ramea.*" Arbeit. Zool. Inst. Graz. i, No. 3, p. 153, 1886; and Zeitsch. Wiss. Zool., xliv, p. 507, 1886.

65. Id. "Korallenstudien. *Madracis pharensis.*" Zeitsch. Wiss. Zool., li, p. 677, 1891.

66. Hertwig, Oscar and Richard. "Die Actinien Anatomisch und Histologisch mit Besonderer Berücksichtigung des Nervenmuskelsystems Untersucht." Studien zur Blättertheorie, Heft i, Jena, 1879.

67. Hertwig, R. "The Actiniaria." Challenger Reports, Zool., vi, Part xv, 1882.

68. Id. "Actiniaria—Supplement." Challenger Reports, Zool., xxvi, Part lxxiii, 1888.

69. Hickson, Sydney J. "On the Ciliated Groove (Siphonoglyphe) in the stomodæum of the Alcyonarians." Phil. Trans., clxxiv, p. 693, 1883.

70. Id. "The Anatomy of *Alcyonium digitatum*." Quart. Jour. Micr. Sci., xxxvii, p. 343, 1895.

71. Hollard, H. "Monographie du Genre *Actinia*." Ann. Sci. Nat., 3e sér., xv, p. 257, 1851.

72. Iwanzoff, N. "Ueber den Bau, Die Wirkungsweise und die Entwickelung der Nesselkapseln der Cœlenteraten." Bull. Soc. Nat. Moscou, 1896, p. 1.

73. Jickeli, Carl F. "Der Bau der Hydroidpolypen. 1. über den histologischen Bau von Eudendrium Ehrbg. und Hydra L." Morph. Jahrb. viii, p. 373, 1882.

74. Jourdan, Ét. "Recherches Zoologiques et Histologiques sur les Zoanthaires du Golfe de Marseille." (Thèse), 1880.

75. Koch, G. von. "Mittheilungen über Cœlenteraten." Jenaische Zeitsch., xi, 1877.

76. Id. "Bemerkungen über das Skelet der Korallen." Morph. Jahrb., v, p. 316, 1879.

77. Id. "Notizen über Korallen." Morph. Jahrb., vi, p. 355, 1880.

78. Id. "Ueber die Entwicklung des Kalkskeletes von *Astroides calycularis* und dessen morphologische Bedeutung." Mitth. Stat. Neapel., iii, p. 284, 1882.

79. Id. "Mittheilungen über das Kalkskelet der Madreporaria." Morph. Jahrb., viii, p. 85, 1883.

80. Id. "Die Morphologische Bedeutung des Korallenskelets." Biol. Central., ii, p. 533, 1883.

81. Id. "Über das Verhältnis von Skelet und Weichtheilen bei den Madreporen." Morph. Jahrb., xii, p. 154, 1887.

82. Id. "Über *Flabellum*." Morph. Jahrb., xiv, p. 329, 1888.

83. Id. "Über *Caryophyllia rugosa* Moseley." Morph. Jahrb., xv, p. 10, 1889.

84. Id. "Die ungeschlechtliche Vermehrung (Knospung und Stockbildung) von *Madrepora*." Verh. Natur. Gesellsch. Nürnberg, 1893.

85. Id. "Das Skelett der Steinkorallen." Festschrift für Carl Gegenbaur, Leipzig, p. 251, 1896.

86. Köllicker, A. von. "Icones Histologicæ." Leipzig, 1863.

87. Korotneff, M. de. "Organes des sens des Actinies." Archiv. Zool. Exp. Gén., v, p. 203, 1876.

88. Kwietniewski, C. R. "Actiniaria von Ternate." Abhandl. Senckenberg. Gesellsch., xxiii, 1897.

89. Lacaze Duthiers, Henri de. "Développement des Corallaires. Premier Mémoire. Actiniares sans Polypier." Archiv. Zool. Exp. Gén., i, p. 289, 1872.

90. Id. "Développement des Corallaires. Deuxième Mémoire. Actiniares à Polypier." Archiv. Zool. Exp. Gén., ii, p. 269, 1873.

91. Id. "Faune du Golfe du Lion. Évolution du Polypier du Flabellum anthophyllum." Archiv. Zool. Exp. Gén., 3e sér., ii, p. 445, 1894.

92. Id. "Faune du Golfe du Lion. Corallaires-Zoanthaires Sclerodermés." Archiv. Zool. Exp. Gén., 3e sér., v, p. 1, 1897.

93. Id. "Les Caryophyllies de Post-Vendres." Archiv. Zool. Exp. Gén., 3e sér., vii, p. 529, 1899.

94. Ledenfeld, R. von. "The Functions of Nettle Cells." Quart. Jour. Micr. Sci., xxvii, p. 393, 1887.

95. Lindström. "Contributions to the Actinology of the Atlantic Ocean." Kon. Svenska Vet. Akad. Handl., xiv, No. 6, p. 17, 1877.

McMurrich, J. Playfair. "Contributions on the Morphology of the Actinozoa."

96. i. "The structure of *Cerianthus Americanus*." Jour. Morph., iv, p. 131, 1891.

97. ii. "On the Development of the Hexactiniæ." Jour. Morph., iv, p. 303, 1891.

98. iii. "The Phylogeny of the Actinozoa." Jour. Morph., v, p. 125, 1891.

99. iv. "On some irregularities in the number of the Directive Mesenteries in the Hexactiniæ." Zoöl. Bull., i, No. 3, p. 115, 1897.

100. v. "The Mesenterial Filaments in *Zoanthus sociatus* (Ellis)." Zoöl. Bull., ii, No. 6, p. 251, 1899.

101. Minchin, E. A. "Investigations on the Development of Trypanosomes in Tsetse-Flies and other Diptera." Quart. Jour. Micr. Sci., lii, p. 159, 1908.

102. Id. "An Introduction to the study of the Protozoa." 1912.

103. Möbius, Karl. "Ueber den Bau, den Mechanismus und die Entwickelung der Nesselkapseln einiger Polypen und Quallen." Abh. Ver. Hamburg, v, p. 1, 1866.

104. Moroff, Theodor. "Entwicklung der Nesselzellen bei *Anemonia*." Archiv. Zellforsch. iv, p. 142, 1910.

105. Moseley, H. N. "Report on the Deep Sea Madreporaria." Challenger Reports, Zool., ii, Part vii, 1881.

106. Murbach, Lewis. "Beiträge zur Kenntnis der Anatomie und Entwickelung der Nesselorgane der Hydroiden." Arch. Naturg., i, Jahrg. 60, p. 217, 1894.

107. Nussbaum, M. "Ueber die Theilbarkeit der lebendigen Materie. ii, Beiträge zur Naturgeschichte des Genus Hydra." Archiv. Mikr. Anat., xxix, p. 265, 1887.

108. Ogilvie, Maria M. "Microscopic and Systematic Study of Madreporarian Types of Corals." Phil. Trans., clxxxvii, 83, 1896.

109. Id. "Note on the Formation of the Skeleton in the Madreporaria." Quart. Jour. Micr. Sci., li, p. 473, 1907.

110. Parker, G. H. "The Mesenteries and Siphonoglyphs in *Metridium marginatum*, Milne Edwards." Bull. Mus. Comp. Zool., xxx, No. 5, p. 259, 1897.

111. Pesch, van A. J. "The Antipatharia of the Siboga Expedition." Monogr. xvii, Leiden, 1914.

112. Pratt, E. M. "Anatomy of *Neohelia porcellana* (Moseley)." Willey Zool. Results, Part v, p. 591, 1900.

113. Salvin-Moore, J. E., and Breinl, A. "The Cytology of the Trypanosomes, Part i." Ann. Trop. Med. Parasitology, i, p. 441, 1908.

114. Schneider and Rötteken. "On the Structure of the Actiniæ and Corals." Ann. Mag. Nat. Hist., vii, p. 437, 1871.

115. Schneider, K. C. "Mittheilungen über Siphonophoren: v, Nesselzellen." Arb. Zool. Inst. Wien, xii, p. 133, 1900.

116. Sclater, W. L. "On a New Madreporarian Coral of the Genus *Stephanotrochus* from the British Seas, with Notes on its Anatomy." Proc. Zool. Soc. London, 1886, p. 128.

117. Sedgwick, A. "On the Inadequacy of the Cellular Theory of Development, and on the Early Development of Nerves, particularly of the Third Nerve and of Sympathetic in Elasmobranchii." Quart. Jour. Micr. Sci., xxxvii, p. 87, 1894.

118. Id. "Further Remarks on the Cell-Theory, with a Reply to Mr Bourne." Quart. Jour. Micr. Sci., xxxviii, p. 331, 1895.

119. Weismann, A. "Die Entstehung der Sexualzellen bei den Hydromedusen." Jena, 1883.

120. Willem, Victor. "La Digestion chez les Actinies." Bull. Soc. Médicine de Gand, p. 295, 1892.

121. Wilson, E. B. "The mesenterial Filaments of the Alcyonaria." Mitth. Zool. Stat. Neapel, v, p. 1, 1884.

122. Wilson, Henry V. "On the Development of *Manicina areolata*." Jour. Morph., ii, p. 191, 1889.

EXPLANATION OF PLATES*

PLATES 1—10: ANATOMY OF THE POLYPS

Lettering employed.

Alg. Alga. *alg. nu.* Nucleus of alga. *ax.* Axis of nematocysts II. *ax. sh.* Sheath of axis of nematocysts II. *C. ect.* Calicoblastic layer of ectoderm. *C. nu.* Nuclei of calicoblastic ectoderm. *Col. end.* Endoderm of column-wall. *Col. mg.* Mesoglæa of column-wall. *d. v.* Digestive vacuoles. *dir. m.* Directive mesentery. *ect.* Ectoderm. *ect. nu.* Nuclei of ectoderm. *end.* Endoderm. *end. nu.* Nuclei of endoderm. *ent. mus.* Entocœlic muscle-fibres of mesentery. *ent. pl.* Entocœlic mesoglæal pleats of mesentery. *ent. t.* Entocœlic tentacle. *ex. pl.* Exocœlic mesoglæal pleats of mesentery. *ex. mus.* Exocœlic muscle-fibres of mesentery. *ex. t.* Exocœlic tentacle. *g.c.* Germ-cells. *gr. v.* Granular vacuole. *in. m.* Inner wall of gonad. *lat. l.* Lateral lobe of mesenterial filament. *m.* Mesentery. *m. end.* Mesenterial endoderm. *m. f.* Mesenterial filament. *m. mg.* Mesenterial mesoglæa. *m. l.* Outer limiting membrane of calicoblastic ectoderm. *md. l.* Median lobe of mesenterial filament. *mg.* Mesoglæa. *muc. v.* Mucous vacuole. n_1. Type I nematocyst. n_2. Type II nematocyst. n_{2b}. Type II_b nematocyst. n_{2c}. Type II_c nematocyst. n_3. Type III nematocyst. n_{3b}. Type III_b nematocyst. *n. l.* Nervous layer. *n. r.* Probable stage in the development of nematocyst II_b. *ov. b.* Ovoid bodies. *ov. nu.* Nucleus of ovum. *ov. nul.* Nucleolus of ovum. *py.* Pyrenoid of alga. *st. end.* Stomodæal endoderm. *st. mg.* Stomodæal mesoglæa. *st. r.* Ectodermal ridge of stomodæum. *sub. b.* Sub-terminal tentacular battery of nematocysts. *t. end.* Endoderm of tentacle. *t. mg.* Mesoglæa of tentacle. *ter. b.* Terminal tentacular battery of nematocysts. *th.* Thread of nematocyst III. *th. sh.* Sheath of thread of nematocyst III.

Plate 1.

Fig. 1. *Cyphastrea serailia* (Forsk.). (Figs. 1—9 all from the same male polyp.) Transverse section through inner wall of edge-zone, showing calicoblastic ectoderm, endoderm with varying nuclei, and algæ with granular nuclei and pyrenoids. (102_b IV, $s_1 4_5$.)† × 900.

Fig. 2. Id. Transverse section through outer wall of edge-zone, showing ectoderm with granular nuclei, some with processes to mesoglæa. (102_b IV, $s_1 3_2$.) × 900.

Fig. 3. Id. Longitudinal section through an exocœlic tentacle to show the histology. (102_b IV, $s_1 3_2$.) × 433.

Fig. 4. Id. Transverse section through a primary mesentery and part of the stomodæal wall. Note that the algæ occur principally on the exocœlic side of the mesentery, and that the mesentery is contracted in a radial direction. (102_b IV, $s_1 5_4$.) × 210.

Fig. 5. Id. Transverse section showing a downward extension of the same ridge and of two lateral extensions of the ectoderm on either side, these lower forming the median and lateral lobes of a mesenterial filament (cp. fig. 6). Semi-diagrammatical. (102_b IV, $s_1 5_8$.)

Fig. 6. Id. Transverse section through straight region of the same mesenterial filament. Semi-diagrammatical. (102_b IV, $s_2 1_4$.)

Fig. 7. Id. Group of brown vacuoles from the convoluted region of a mesenterial filament towards the base of polyp, surrounding a mass of nucleated protoplasm, each sac with a deeper stained spot in its inner bluntly-pointed end. (102_b IV, $s_3 1_3$.) × 400.

* The mesenterial musculature is marked only in figs. 3, 4, 14 and 27. In all the other sections of the mesenteries it is omitted for the sake of clearness.

† This refers to the number of the section.

Fig. 8. *Cyphastrea serailia* (Forsk.). Nematocyst II. (102_b IV, $s_2 4_{21}$.) × 1700.

Fig. 9. Id. Transverse section through a primary mesentery with testis containing triangular-shaped spermatozoa. (102_b IV, $s_2 2_7$.) × 350.

Fig. 10. Id. Transverse section through a primary mesentery of a female polyp, bearing a ripe ovum and two groups of germ-cells. (102_b VI, $s_2 2_9$.) × 193.

Fig. 11. *Cyphastrea chalcidicum* (Klunz.). Longitudinal section through a primary entocœlic tentacle containing a terminal battery and sub-terminal batteries. In the centre of the tentacle lay a septum, which has been decalcified, and the endoderm of the tentacle has by contraction come to lie in contact with the body-wall (endoderm and calicoblastic ectoderm) over the septum. (200_b I, $s_1 3_1$.) × 180.

Fig. 12. *Cyphastrea suvadivæ*, Gard. Longitudinal section through a primary entocœlic tentacle containing a terminal battery and a pair of sub-terminal batteries. (102_a I, $s_1 3_1$.) × 240.

Plate 2.

Fig. 13. *Cyphastrea chalcidicum* (Klunz.). Transverse section through a primary mesentery and part of the stomodæal wall. (200_b I, $s_1 4_{12}$.) × 180.

Fig. 14. *Cyphastrea suvadivæ*, Gard. Transverse section through a primary mesentery and part of the stomodæal wall. (102_a I, $s_1 4_5$.) × 180.

Fig. 15. Id. Nematocyst III from convoluted region of a mesenterial filament. (102_a I, $s_1 1_1$.) × 1450.

Fig 16. *Echinopora hirsutissima*, Ed. and H. Nematocyst III*b* from convoluted region of a mesenterial filament. (107_c II, $s_{11} 2_2$.) × 900.

Fig. 17. Id. Transverse section through convoluted region of a mesentery. Nematocysts III*b* arranged in batteries. (107_c II, $s_{10} 2_7$.) × 115.

Fig. 18. Id. Nematocyst II from convoluted region of a mesenterial filament, its axis extending beyond two-thirds the length of its sac. (107_b I, $s_3 1_1$.) × 950.

Fig. 19. Id. Longitudinal section through an entocœlic tentacle bearing a large terminal battery and about six tub-terminal batteries on each side. Algæ rare. (107_c I, $s_4 2_2$.) × 105.

Fig. 20. Id. Transverse section through a primary mesentery and part of the stomodæal wall. (107_c II, $s_6 1_6$.) × 80.

Fig. 21. *Echinopora lamellosa* (Esper). Transverse section through a primary mesentery and part of the stomodæal wall. (107_g II, $s_3 2_1$.) × 115.

Fig. 22. *Echinopora gemmacea* (Lam.). Transverse section through a primary mesentery and part of the stomodæal wall. The mesentery is somewhat contracted in a radial direction. Algæ few. (204_a II, $s_3 4_2$.) × 115.

Fig. 23. *Galaxea fascicularis* (Linn.). Transverse section through a primary mesentery and part of the stomodæal wall. (201_a II, $s_{10} 1_1$.) × 55.

Fig. 24. Id. Transverse section through outer wall of edge-zone. Cp. with Pl. **1**, fig. 2, and note thick ectoderm with many nuclei and ovoid bodies, and swollen endoderm with algæ rare. (201_a II, s_6.) × 600.

Plate 3.

Fig. 25. *Galaxea fascicularis* (Linn.). Transverse section through inner wall of edge-zone near attachment of a mesentery to the outer surface of the corallum, showing calicoblastic ectoderm greatly thickened with piled up nuclei. (201_a II, $s_5 2_3$.) × 400.

Fig. 26. *Galaxea fascicularis* (Linn.) Longitudinal section through an exocœlic tentacle containing a terminal and numerous sub-terminal batterics. Nematocysts II *b* mainly forming the terminal battery; as in *all species* only type I in sub-terminal batteries. (201_a II, $s_{10}1_1$.) × 80.

Fig. 27. Id. Transverse section of the mesoglæa of a primary mesentery in the stomodæal region to show the greatly sub-divided condition of the entocœlic pleats. (201_a II, $s_8 2_2$.) × 633.

Fig. 28. *Galaxea musicalis* (Linn.). Longitudinal section through an entocœlic and an exocœlic tentacle. As in Pl. 1, fig. 11, the endoderm of the tentacles lies in contact with the endoderm of the body-wall. (101_a II, $s_1 3_{10}$.) × 766.

Fig. 29. Id. Transverse section through two mesenteries, each with a ripe egg projecting into the exocœle between; the upper part of a succeeding egg partially overlaps one of these. Vacuolated appearance of column-wall endoderm and lower ends of mesenterial filaments to be noted. (101_a II, $s_2 3_9$.) × 766.

Fig. 30. *Leptastrea roissyana*, Ed. and H. Longitudinal section through a primary entocœlic tentacle with terminal battery only. (202_m II, $s_1 2_5$.) × 110.

Fig. 31. Id. Transverse section through a primary mesentery and part of the stomodæal wall. Algæ abundant on the exocœlic side. (202_n I, $s_2 4_8$.) × 120.

Fig. 32. *Diploastrea heliopora* (Lam.). Transverse section through a primary mesentery at the level of the stomodæum. In outline to indicate the ento- and exocœlic pleats. (104_k I, $s_9 1_1$.) × 60.

Fig. 33. *Leptastrea roissyana*, Ed. and H. Nematocyst II *b*. (202_n I, $s_2 2_6$.) × 1700.

Fig. 34. *Diploastrea heliopora* (Lam.). Nematocyst II from the convoluted part of a mesenterial filament. (104_k III, $s_{25}1_4$.) × 950.

Plate 4.

Fig. 35. *Favia favus* (Forsk.). Stages *a*—*g* in the development of a nematocyst I. From the ectoderm of oral-disc. (202_p I, s_7.) × 1500.

Fig. 36. Id. Transverse section through principal mesentery and part of the stomodæal wall. (202_p I, $s_{15}3_4$.) × 60.

Fig. 37. Id. Stages *a*—*f* in the development of a nematocyst II. From the ectoderm of oral-disc (202_p I, s_7.) × 1500.

Fig. 38. Id. Nematocyst II from convoluted region of a mesenterial filament. (202_p I, $s_{14}2_4$.) × 900.

Fig. 39. Id. Early stages in the formation of the axis of nematocyst II. From nuclei in mesenterial filament. (202_p I, s_{16}.) × 1500.

Fig. 40. Id. Nematocyst III with the thread partially extruded. (202_p I, $s_{19}2_5$.) × 900.

Fig. 41. *Favia doreyensis*, Ed. and H. Transverse section through a principal mesentery and part of the stomodæal wall. In the pleatal region algæ are more abundant on the exocœlic side, while in the non-pleatal region they occur principally on the entocoelic side. (106_d I, $s_{18}1_4$.) × 55.

Fig. 42. *Favia hululensis*, Gard. Transverse section through a principal mesentery and part of the stomodæal wall. (106_a I, $s_{12}2_1$.) × 80.

Fig. 43. *Favia clouei* (Valen.). Transverse section through a principal mesentery and part of the stomodæal wall. (304_p II, $s_7 2_1$.) × 43.

Plate 5.

Fig. 44. *Favia doreyensis*, Ed. and H. Longitudinal section through an entocœlic tentacle. Stages in the development of nematocyst I in terminal battery; and vacuolization in ectoderm and endoderm. Algæ scarce. (106_c I, $s_{17}1_1$.) × 185.

Fig. 45. *Favia doreyensis*, Ed. and H. Transverse section of the straight region of a principal mesentery and its filament. Note nematocysts II in endoderm. (106_c I, $s_{22}2_1$.) × 150.

Fig. 46. *Favia abdita* (Ell. and Sol.). Transverse section through a principal mesentery and part of the stomodæal wall. (103_e I, $s_9 2_2$.) × 55.

Fig. 47. *Favia bertholleti* (Valen.). Transverse section through a principal mesentery and part of the stomodæal wall. (305_b I, $s_9 2_7$.) × 80.

Fig. 48. *Favia pentagona* (Esper). Transverse section through a principal mesentery and part of the stomodæal wall. (106_b III, $s_5 3_7$.) × 75.

Fig. 49. *Favia hululensis*, Gard. Transverse section through a mesentery with three ova. Note germ-cells. Cp. Pl. **1**, fig. 10 and Pl. **6**, fig. 67. (106_a I, $s_{17}1_1$.) × 153.

Fig. 50. *Favia ananas* (Ell. and Sol.). Transverse section through a principal mesentery and part of the stomodæal wall. (202_b III, $s_5 2_{13}$.) × 80.

Fig. 51. *Favia hululensis*, Gard. Transverse section through oral-disc. Note ectoderm with a row of oval vacuoles. (106_a I, $s_4 3_2$.) × 600.

Fig. 52. *Favia pentagona* (Esper). Transverse section through oral-disc. Nematocysts I more abundant in ectoderm than in any other species of *Favia*. Cp. with fig. 51. (106_b I, $s_5 3_1$.) × 650.

Fig. 53. Id. Transverse section through column-wall near the surface of the corallum. Note wedge-shaped processes of attachment in the calicoblastic layer and remarkable regularity in the processes to the mesoglæa from the nuclei of both layers. Cp. with fig. 52. (106_b I, $s_3 2_6$.) × 650.

Plate 6.

Fig. 54. *Goniastrea solida* (Ed. and H.). Transverse section through a principal mesentery and part of the stomodæal wall. (106_f I, $s_6 2_1$.) × 80.

Fig. 55. *Goniastrea retiformis* (Lam.). Transverse section through a principal mesentery and part of the stomodæal wall. Note somewhat regular arrangement of vacuoles in the endoderm in the pleatal region. Algæ scarce. (105_a I, $s_3 2_5$.) × 110.

Fig. 56. *Goniastrea pectinata* (Ehrh.). Transverse section through a principal mesentery and part of the stomodæal wall. (203_c I, $s_{10}1_7$.) × 80.

Fig. 57. *Favia hululensis*, Gard. Transverse section through a nematocyst III. Note membranous wall and protoplasmic core. (106_a I, s_{15}.) × 1450.

Fig. 58. *Goniastrea solida* (Ed. and H.). Transverse sections *a* and *b*, through two nematocysts II *c* passing through their axes at different levels. (106_f I, $s_4 2_2$.) × 1450.

Fig. 59. Id. Transverse section through the convoluted region of a mesentery. Nematocysts II *c* arranged to form batteries. Cp. with Pl. **2**, fig. 17. (106_f I, $s_4 3_9$.) × 1450.

Fig. 60. *Favia hululensis*, Gard. Nematocyst III. The spiral of thread is only faintly visible in the unextruded condition. (106_a I, $s_{18}1_5$.) × 950.

Fig. 61. *Goniastrea retiformis* (Lam.). Nematocyst III. Note narrow sac. Cp. with figs. 16 and 60. (105_b III, $s_4 1_8$.) × 950.

Fig. 62. Id. Nematocyst II. Cp. with Pl. **4**, fig. 37_f, and note narrower sac and shorter axis. (105_b III, $s_4 3_4$.) × 950.

Fig. 63. *Galaxea fascicularis* (Linn.). Nematocyst I from terminal battery of tentacle. (201_a II, $s_9 1_1$.) × 1600.

Fig. 64. Id. Nematocyst II *b* from terminal battery of tentacle. (201_a II, $s_9 1_1$.) × 950.

Fig. 65. *Favia favus* (Forsk.). Fully developed nematocyst I from a terminal battery of a tentacle. (202_p I, $s_{12}2_2$.) × 1600.

Fig. 66. *Favia abdita* (Ell. and Sol.). Transverse section through a mesenterial filament. (103_p I, $s_{10}1_1$.) × 380.

Fig. 67. Id. Transverse section through a principal mesentery, containing ova and germ-cells. (103_p I, $s_{35}2_5$.) × 185.

Plate 7.

Transverse sections:

Fig. 1. *Cyphastrea chalcidicum* (Klunz.). Stomodæal region of giant polyp. (200_a II, $s_3 2_3$.) × 30.

Fig. 2. *Favia bertholleti* (Val.). Stomodæal region. (305_a II, $s_{13}1_6$.) × 10½.

Fig. 3. *Goniastrea retiformis* (Lam.). Stomodæal region. (301_a I, $s_2 1_{11}$.) × 27.

Fig. 4. *Cyphastrea serailia* (Forsk.). Stomodæal region. (102_b IV, $s_1 5_4$.) × 65.

Fig. 5. *Cyphastrea chalcidicum* (Klunz.). Stomodæal region. (200_b I, $s_1 4_{11}$.) × 45.

Fig. 6. *Cyphastrea microphthalma* (Lam.). Stomodæal region. (200_c I, $s_1 3_7$.) × 45.

Fig. 7. *Cyphastrea suvadivæ*, Gard. Stomodæal region. (102_a I, $s_1 4_5$.) × 65.

Plate 8.

Transverse sections:

Fig. 1. *Leptastrea roissyana*, Ed. and H. Stomodæal region, Ceylon polyp. (300_e I, $s_2 4_8$.) × 27.

Fig. 2. Id. Tentacular region, Donganab polyp. (202_m IV, $s_1 5_6$.) × 35.

Fig. 3. Id. Stomodæal region, Donganab polyp. (202_n I, $s_2 4_{12}$.) × 25.

Fig. 4. *Galaxea fascicularis* (Linn.). Stomodæal region and edge-zone, Donganab polyp. (201_a II, $s_{12}1_3$.) × 10½.

Fig. 5. *Echinopora hirsutissima*, Ed. and H. Stomodæal region, Hulule polyp. (107_b III, $s_6 2_1$.) × 18.

Fig. 6. *Echinopora lamellosa* (Esp.). Stomodæal region and edge-zone, Hulule polyp. (107_g II, $s_3 2_1$.) × 25.

Plate 9.

Transverse sections:

Fig. 1. *Favia doreyensis*, Ed. and H. Stomodæal region, with tentacles, Hulule polyp. (106_c I, $s_{17}1_2$.) × 9.

Fig. 2. *Favia favus* (Forsk.). Stomodæal region, Donganab polyp. (202_f I, $s_{15}3_5$.) × 13.

Fig. 3. *Favia doreyensis* Ed. and H. Stomodæal region, Hulule polyp. (106_d I, $s_{18}1_5$.) × 12.

Fig. 4. *Echinopora hirsutissima*, Ed. and H. Below stomodæal region, Hulule polyp. (107_c II, $s_{10}2_4$.) × 22.

Fig. 5. *Favia abdita* (Ell. and Sol.). Stomodæal region, Salomon polyp. (103_e I, $s_9 2_2$.) × 15.

Fig. 6. *Favia hululensis*, Gard. Stomodæal region, Hulule polyp. (106_a I, $s_{12}1_3$.) × 18.

Plate 10.

Transverse sections:

Fig. 1. *Goniastrea solida* (Ed. and H.). Stomodæal region, Amirante (16 fms.) polyp. (106_f I, $s_5 3_6$.) × 20.

Fig. 2. *Favia ananas* (Ell. and Sol.). Stomodæal region, Donganab polyp. (202_b III, $s_5 2_6$.) × 25.

Fig. 3. *Goniastrea retiformis* (Lam.). Stomodæal region, Hulule polyp. (105_a I, $s_3 1_{10}$.) × 35.

Fig. 4. *Favia ananas* (Ell. and Sol.). Below stomodæal region. (Cp. Pl. 9, fig. 4.) (202_b III, $s_6 1_8$.) × 25.

Fig. 5. *Favia pentagona* (Esp.). Stomodæal region, Hulule polyp. (106_b III, $s_6 1_3$.) × 23.

Fig. 6. *Favia clouei* (Val.). Stomodæal region, Ceylon polyp. (304_p II, $s_7 1_3$.) × 14.

PLATES 11—38: CORALLA.

Plate 11.

Cyphastrea serailia (Forskål).

Fig. 1. No. 1 on p. 46. × 3.

Fig. 2. No. 4 on p. 46. Typical form. × 3.

Fig. 3. Typical specimen. × 3.

Figs. 4—9. Type specimens of *Madrepora serailia*, Forskål, Copenhagen. Each × 3.

Plate 12.

Fig. 1. *Cyphastrea chalcidicum* (Klunz.). No. 5 on the list on p. 46. × 3.

Fig. 2. Id. No. 6 on p. 46, showing a giant corallite. × 3.

Fig. 3. Id. Typical form, enlarged view of Pl. **14**, fig. 1. × 3.

Fig. 4. *Cyphastrea microphthalma* (Lam.). No. 15 on p. 47. × 3.

Fig. 5. Id. No. 12 on p. 47. × 3.

Fig. 6. Id. No. 9 on p. 46. × 3.

Fig. 7. Id. No. 11 on p. 47. × 3.

Fig. 8. Id. Typical form. × 3.

Fig. 9. Id. Type of *Astrea microphthalma*, Lamarck, Paris. × 3.

Plate 13.

Fig. 1. *Cyphastrea microphthalma* (Lam.). Type of *Cyphastræa savignyi*, Ed. & H., Paris. × 3.

Fig. 2. Id. Type of *Madrepora serailia*, Forskål, Copenhagen. × 3.

Fig. 3. *Cyphastrea suvadivæ*, Gard. Type from Felidu of *Cyphastrea maldivensis*, Gard. × 3.

Fig. 4. *Cyphastrea gardineri*, n. sp. No. 22 on p. 47. × 3.

Fig. 5. Id. No. 20 on p. 47, typical form. × 3.

Fig. 6. *Galaxea lamarcki*, Ed. and H. 36 fms., Nilandu, Maldives, typical form. × 3.

Fig. 7. *Cyphastrea microphthalma* (Lam.). No. 16 on p. 47, hillocky form of growth. × ½.

Fig. 8. *Cyphastrea serailia* (Forsk.). No. 1 on p. 46, convex form of growth. × ½.

Plate 14.

Fig. 1. *Cyphastrea chalcidicum*, Klunz. Typical form, enlarged on Pl. **12**, fig. 3. × ½.

Fig. 2. *Echinopora lamellosa* (Esp.). Typical form, enlarged view of Pl. **16**, fig. 6. × 2.

Fig. 3. *Echinopora lamellosa* (Esp.). No. 1 on p. 57. × 2.

Fig. 4. Id. No. 2 on p. 57. × 2.

Fig. 5. Id. No. 4 on p. 57. × 2.

Fig. 6. Id. No. 5 on p. 57. × 2.

Fig. 7. *Echinopora hirsutissima*, Ed. and H. No. 7 on p. 57. Variant towards *E. lamellosa* (Esp.). × 2.

Fig. 8. Id. Typical form. × 2.

Fig. 9. *Echinopora gemmacea* (Lam.). Typical form. × 2.

Plate 15.

Fig. 1. *Echinopora lamellosa* (Esp.). Corallites near edge. × 2.

Fig. 2. *Echinopora hirsutissima*, Ed. and H. No. 8 on p. 57. × 2.

Fig. 3. Id. No. 9 on p. 57. × 2.

Fig. 4. Id. Type of *Echinopora hirsutissima*, Ed. and H., Paris. × 1.

Fig. 5. *Echinopora gemmacea* (Lam.). Type of *Echinopora solidior*, Ed. and H., Paris. × 1.

Fig. 6. Id. No. 12 on p. 57. × 1.

Plate 16.

Fig. 1. *Galaxea lamarcki* (Ed. and H.). Dredged, Felidu, 25 fms.

Fig. 2. *Galaxea musicalis* (Linn.). Enlarged view of fig. 3.

Fig. 3. Id. Typical form from N. Male.

Fig. 4. *Galaxea fascicularis* (Linn.). Specimen from which polyps were taken, typical form.

Fig. 5. *Echinopora gemmacea* (Lam.). The *fruticulosa* type of growth.

Fig. 6. *Echinopora lamellosa* (Esp.). Typical form (see Pl. **14**, fig. 2).

Fig. 7. *Echinopora gemmacea* (Lam.). No. 13 on p. 57.

Fig. 8. Id. No. 10 on p. 57, irregular mode of growth.

Plate 17.

Fig. 1. *Echinopora hirsutissima*, Ed. and H. *Tertia* facies. × 2.

Fig. 2. *Echinopora gemmacea* (Lam.). No. 14 on p. 57. × 2.

Fig. 3. Id. No. 13 on p. 57, enlarged view of Pl. **16**, fig. 7. × 2.

Fig. 4. *Leptastrea roissyana*, Ed. and H. No. 1 on p. 71. × 2.

Fig. 5. *Leptastrea ehrenbergana*, Ed. and H. Enlarged view of fig. 7. × 2.

Fig. 6. Id. No. 9 on p. 71. × 2.

Fig. 7. Id. Typical form. × 1.

Fig. 8. *Leptastrea solida* (Ed. and H.). No. 13 on p. 71. × 1½.

Fig. 9. Id. No. 10 on p. 71. × 1½.

Plate 18.

Fig. 1. *Leptastrea roissyana*, Ed. and H. Typical form. Enlarged view of Pl. **19**, fig. 1. × 2.

Fig. 2. *Leptastrea ehrenbergana*, Ed. and H. No. 8 on p. 71, region with small corallites. × 2.

Fig. 3. *Leptastrea solida* (Ed. and H.). No. 11 on p. 71. × 1½.

Fig. 4. Id. Typical form, two double corallites. Enlarged view of Pl. **19**, fig. 6. × 2.

Fig. 5. Id. No. 14 on p. 71, showing three giant corallites. × 2.

Fig. 6. Id. No. 12 on p. 71, also with giant corallites. × 2.

Fig. 7. *Leptastrea ehrenbergana*, Ed. and H. No. 8 on p. 71, region with large corallites. Cp. fig. 2. × 2.

Fig. 8. *Leptastrea solida* (Ed. and H.). Figured type of *Cyphastrea bottai*, Ed. and H., Paris. × 3.

Plate 19.

Fig. 1. *Leptastrea roissyana*, Ed. and H. Typical form, enlarged on Pl. **18**, fig. 1. × ⅓.

Fig. 2. Id. No. 2 on p. 71. × 1.

Fig. 3. *Leptastrea ehrenbergana*, Ed. and H. No. 6 on p. 71. × 1.

Fig. 4. Id. No. 5 on p. 71. × 1.

Fig. 5. *Leptastrea solida* (Ed. and H.). No. 15 on p. 71. × 1.

Fig. 6. Id. Typical form, enlarged on Pl. **18**, fig. 4. × 1.

Plate 20.

Fig. 1. *Favia favus* (Forsk.). From Red Sea, var. 2. × 1.

Fig. 2. Id. From Seychelles, var. 1. × 1.

Fig. 3. Id. From Red Sea, var. 1, deep corallites and weak columella. × 1.

Fig. 4. Id. From Red Sea, var. 2. × 1.

Fig. 5. Id. From Red Sea, enlarged view of Pl. **32**, fig. 1. × 1.

Fig. 6. Id. From Red Sea, typical form. × 1.

Fig. 7. *Diploastrea heliopora* (Lam.). From Minikoi, edge region. × 2.

Fig. 8. Id. One of the types of *Astrea heliopora*, Lam., = *Heliastræa heliopora*, Ed. and H. × 1.

Plate 21.

Fig. 1. *Favia favus* (Forsk.). From Red Sea. Corallite rims distinct as in Group I. × 1.

Fig. 2. Id. From Red Sea. Corallum with distorted growth due to unfavourable conditions. × 1.

Fig. 3. Id. From Red Sea. Heavy corallum with thickened walls and small corallites, var. 2. × 1.

Fig. 4. ? Id. Gardiner's *F. versipora*. Cp. Klunzinger's figure of *F. ehrenbergi*. × 1.

Fig. 5. Id. Type of *Favia rousseaui*, Ed. and H., Paris. × 1.

Fig. 6. ? Id. Type of *F. affinis*, Ed. and H., Paris. × 1.

Fig. 7. Id. One of the types of *Favia jacquinoti*, Ed. and H., Paris. × 1.

Fig. 8. Id. Type of *Astrea denticulata*, Lam., Paris. × 1.

Plate 22.

Figs. 1—4. *Favia favus* (Forsk.). Four types of *Madrepora favus*, Forskål, Copenhagen. Fig. 3 is a typical form ; fig. 4, belonging to var. 2, resembles Pl. **20**, fig. 4. × 1.

Fig. 5. Id. Type of *Madrepora cavernosa*, Forskål, Copenhagen. Typical form of *F. favus*. × 1.

Fig. 6. *Favia hululensis*, Gardiner. Large specimen from Ceylon. × 1.

Fig. 7. ? *Favia bertholleti* (Val.). One of the types of *Madrepora favus*, Forskål, Copenhagen. Perhaps only a thin-walled *F. favus*. × 1.

Fig. 8. *Favia doreyensis*, Ed. and H. Type of *Favia doreyensis*, Ed. and H., Paris. (Cp. with Gardiner s Pl. lxi, fig. 17.) × 1.

Fig. 9. Id. Specimen in Paris, named both *F. amplior* and *F. ananas*. Perhaps Lamarck's type of *Astrea ananas*, var. *amplioribus*. × 1.

Plate 23.

Fig. 1. *Favia clouei* (Val.). One of the types of *Favia okeni*, Ed. and H., Paris. Corallites larger than usual. × 1.

Fig. 2. Id. Type from Seychelles of *Favia clouei*, Ed. and H., Paris. × 1.

Fig. 3. *Favia versipora* (Lam.). The larger type of *Plesiastræa versipora*, Ed. and H., Paris. × 2.

Fig. 4. *Favia bertholleti* (Val.). Type of *Favia bertholleti*, Ed. and H., Paris. × 1.

Fig. 5. *Favia clouei* (Val.). Four small pieces from Ceylon, from which polyps were taken. Cp. with Klunzinger's figure (Pl. iii, fig. 6) of *F. tubulifera*. × 1.

Fig. 6. *Favia bertholleti* (Val.). Four small pieces from Ceylon, from which polyps were taken; the lower on the right belongs to var. 1, while the two on the left belong to var. 2. × 1.

Plate 24.

Fig. 1. *Favia bertholleti* (Val.). From Aldabra. × 1.

Fig. 2. *Favia pentagona* (Esper). From Minikoi. × 2.

Fig. 3. Id. From Seychelles. × 2.

Fig. 4. Id. From Minikoi. Gardiner's *Stephanocœnia maldivensis*. × 2.

Figs. 5 and 6. *Favia laxa* (Klunz.). Two specimens from Red Sea. × 2.

Fig. 7. *Favia hirsuta* (Ed. and H.). Gardiner's *Acanthastræa hirsuta* var. *megalostoma*. × 1.

Fig. 8. Id. From Red Sea. × 1.

Plate 25.

Fig. 1. *Favia acropora* (Linn.). From Funafuti, Gardiner's *Orbicella orion*. × 3.

Fig. 2. *Favia clouei* (Val.). From Salomon. Cp. with Klunzinger's figure (Pl. iii, fig. 4) of *F. cavernosa*. × 1.

Fig. 3. *Favia acropora* (Linn.). From Salomon. × 3.

Fig. 4. *Favia wakayana* (Gard.). From Rotuma. Gardiner's *Orbicella versipora*. × 2.

Fig. 5. *Favia versipora* (Lam.). From Rotuma. Gardiner's *Orbicella acropora*. × 2.

Fig. 6. Id. From Minikoi. Gardiner's *Orbicella annuligera*. × 2.

Fig. 7. *Favia ananas* (Ell. and Sol.). Specimen from Red Sea, from which polyps were taken. × 2.

Fig. 8. *Favia solidior* (Ed. and H.). Type of *Heliastræa solidior*, Ed. and H., Paris. × 1.

Fig. 9. *Favia versipora* (Lam.). The type of *Heliastræa laperouseana*, Ed. and H., Paris. × 1.

Plate 26.

Figs. 1 and 2. *Favia hombroni* (Rouss.). Two specimens from Salomon. × 2.

Fig. 3. *Favia halicora* (Ehr.). From Minikoi. Gardiner's var. *obtusa*. × 1.

Fig. 4. *Favia acropora* (Linn.). Large type from Indian Ocean of *Heliastræa acropora*, Ed. and H., Paris. × 3.

Figs. 5—7. *Favia halicora* (Ehr.). Three specimens from Salomon, showing extent of variation, from thin-walled polygonal corallites without surrounding grooves to oval or circular thick-walled corallites with distinct furrows. × 1.

Plate 27.

Figs. 1 and 2. *Favia hemprichii* (Ehr.). Two specimens from Seychelles. × 1.

Fig. 3. *Favia vasta*, Klunz. From Egmont, Chagos. Cp. with Klunzinger's figure (Pl. iv, fig. 8) of *F. vasta* var. superficialis. × 1.

Fig. 4. *Favia hemprichii* (Ehr.). From Minikoi. Gardiner's *Acanthastræa hirsuta* var. *microstoma*. × 1.

Fig. 5. *Favia vasta*, Klunz. From Salomon. Cp. with Klunzinger's Pl. iv, fig. 12. × 1.

Fig. 6. Id. From Aldabra. Resembles Klunzinger's *Goniastræa halicora* var. *obtusa* (Pl. iv, fig. 2). × 1.

Plate 28.

Fig. 1. *Favia solidior* (Ed. and H.). From Funafuti. Gardiner's *Orbicella coronata*. × 1.

Fig. 2. *Favia favosa* (Ell. and Sol.). From Red Sea. × 1.

Fig. 3. *Goniastrea solida* (Ed. and H.). From Hulule. × 3.

Fig. 4. Id. Specimen from Amirante (16 fms.), from which polyps were taken. × 3.

Fig. 5. *Goniastrea planulata*, Ed. and H. From Turadu. Gardiner's *Goniastræa pectinata*. × 2.

Fig. 6. *Goniastrea pectinata* (Ehr.). From Red Sea, enlarged view of Pl. **37**, fig. 1. × 2.

Plate 29.

Favia abdita (Ell. and Sol.). Specimens showing extent of skeletal variation; figs. 2—4, Gardiner's *Prionastræa fusco-viridis*.

Fig. 1. From Singapore (cp. with Pl. **35**, fig. 2, and Ellis and Solander's Pl. 50, fig. 2). × 1.

Fig. 2. Id. From Goidu. × 1.

Fig. 3. Id. From Minikoi. × 1.

Fig. 4. Id. From Minikoi. × 1.

Plate 30.

Figs. 1—3. *Favia complanata*, Ehr. Three specimens from Red Sea, showing imitation of *Favia abdita* in form of growth and mode of skeletal variation. Cp. with Pl. **29**, fig. 1—4. × 1.

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Plate 31.

Fig. 1. *Goniastrea retiformis* (Lam.). From Rotuma. × 3.

Fig. 2. Id. From Seychelles. × 3.

Figs. 3 and 4. Id. Two specimens from Minikoi. × 3.

Fig. 5. Id. From Red Sea, enlargement of Pl. **33**, fig. 3. × 3.

Fig. 6. *Goniastrea solida* (Ed. and H.). From Seychelles, enlargement of Pl. **33**, fig. 4. × 3.

Fig. 7. *Goniastrea planulata*, Ed. and H. Type of the species, Paris. × 1.

Fig. 8. Id. From Egmont, Chagos. × 1.

Plate 32.

Fig. 1. *Favia favus* (Forsk.). From Red Sea. × $\frac{1}{3}$. (Pl. **20**, fig. 5, same × 1.)

Fig. 2. *Favia doreyensis*, Ed. and H. From Seychelles. × $\frac{2}{3}$.

Fig. 3. Id. From Minikoi, Gardiner's *Orbicella borradailei*. × $\frac{2}{3}$.

Fig. 4. Id. Type of *Astrea rotulosa*, Lamarck, Paris. × 1.

Plate 33.

Fig. 1. *Favia acropora* (Linn.). From Salomon; typical humpy mode of growth. × 1.

Fig. 2. *Favia hombroni* (Rouss.). From Salomon. × 1.

Fig. 3. *Goniastrea retiformis* (Lam.). From Red Sea, typical, even, round or convex mode of growth; enlarged on Pl. **31**, fig. 5. × $\frac{1}{2}$.

Fig. 4. *Goniastrea solida* (Ed. and H.). From Seychelles, enlarged on Pl. **31**, fig. 6. × $\frac{1}{2}$.

Plate 34.

Vertical sections of coralla:

Fig. 1. *Favia clouei* (Val.). Specimens on Pl. **23**, fig. 5. × 1.

Fig. 2. *Galaxea lamarcki*, Ed. and H. Specimen on Pl. **13**, fig. 6. × 2.

Fig. 3. *Galaxea fascicularis* (Linn.). Specimen on Pl. **16**, fig. 4. × 2.

Fig. 4. *Cyphastrea microphthalma* (Lam.). No. 14 on p. 47. × 3.

Fig. 5. *Cyphastrea gardineri*, n. sp. Specimen on Pl. **13**, fig. 5. × 3.

Fig. 6. *Cyphastrea suvadivæ*, Gard. Specimen on Pl. **13**, fig. 3. × 3. (Cp. with fig. 2.)

Fig. 7. *Echinopora hirsutissima*, Ed. and H. Specimen on Pl. **17**, fig. 1. × 2. (Cp. with Gardiner's Pl. lix, fig. 6.)

Fig. 8. *Leptastrea ehrenbergana*, Ed. and H. Specimen on Pl. **17**, fig. 6. × 2.

Fig. 9. *Diploastrea heliopora* (Lam.). Second specimen from Minikoi. × 1½.

Plate 35.

Fig. 1. *Favia hululensis*, Gard. Type of *Favia rotulosa*, Ehrenberg (Mus. no. 739), Berlin. × 1.

Fig. 2. *Favia abdita* (Ell. and Sol.). Type of *Astræa abdita*, Ehrenberg (Mus. no. 729), Berlin. (Cp. with Pl. **29**, fig. 1.) × 1.

Plate 36.

Fig. 1. *Favia favus* (Forsk.). Type of *Astræa deformis*, Ehrenberg (Mus. no. 731), Berlin. × 1.

Fig. 2. Id. Type of *F. favus*, Ehrenberg (Mus. no. 693), Berlin. × 1.

Fig. 3. *Favia hemprichii* (Ehr.). Type of *Astræa hemprichii*, Ehrenberg (Mus. no. 735), Berlin. × 1.

Fig. 4. *Favia pentagona* (Esp.). Type of *Astræa melicerum*, Ehrenberg (Mus. no. 734), Berlin. × 1.

Plate 37.

Fig. 1. *Goniastrea pectinata* (Ehr.). From Red Sea, enlarged on Pl. **28**, fig. 6. × $\frac{2}{3}$.

Fig. 2. *Favia laxa* (Klunz.). From Red Sea, rounded form of growth, enlarged on Pl. **24**, fig. 5. × 1.

Fig. 3. *Favia versipora* (Lam.). Type of *Heliastræa annuligera*, Ed. and H., Paris. × 3.

Fig. 4. *Leptastrea roissyana*, Ed. and H. Vertical section through specimen on Pl. **19**, fig. 1. × 2.

Fig. 5. *Echinopora gemmacea* (Lam.). Vertical section through No. 11 on p. 57. × 2.

Plate 38.

Fig. 1. *Cyphastrea serailia* (Forsk.). Enlarged view of part of fig. 5 below. × 3.

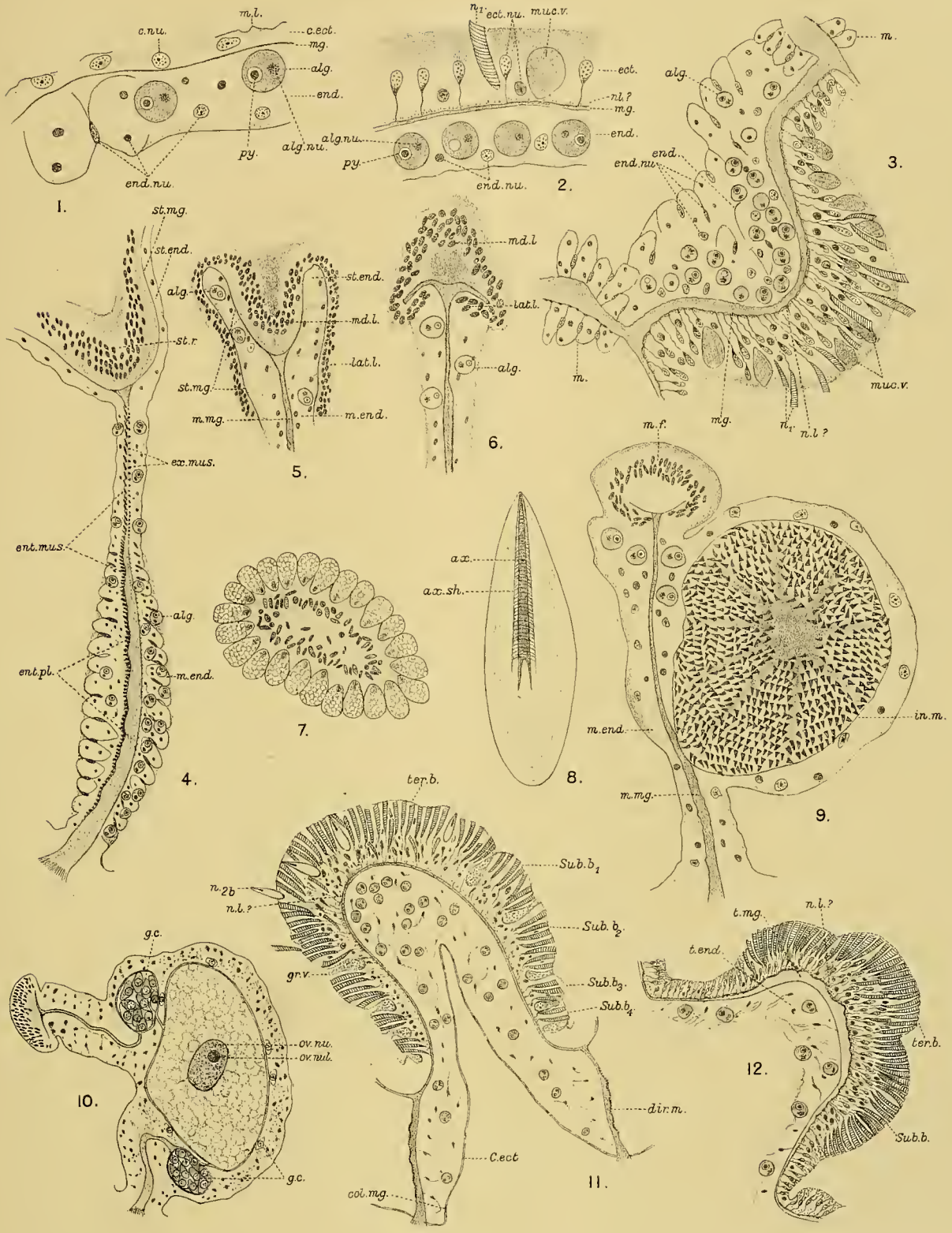
Fig. 2. *Goniastrea retiformis* (Lam.). Enlarged view of part of fig. 4 below. (I have not personally examined this nor the next specimen.) × 2.

Fig. 3. *Goniastrea solida* (Ed. and H.). One of the types of *Goniastræa favus*, Klunz., in the Stuttgart Museum. × 2.

Fig. 4. *Goniastrea retiformis*. Another of the types of *Goniastræa favus*, Klunz., in the Stuttgart Museum (probably Klunzinger's Pl. iv, fig. 4). × 1.

Fig. 5. *Cyphastrea serailia* (Forsk.). Type of *Favia microphthalma*, Ehrenberg (Mus. no. 713), Berlin. × 1.

Fig. 6. *Galaxea fascicularis* (Linn.). One of the types of *Anthophyllum fasciculare*, Ehrenberg (Mus. no. 624), Berlin. × 1.



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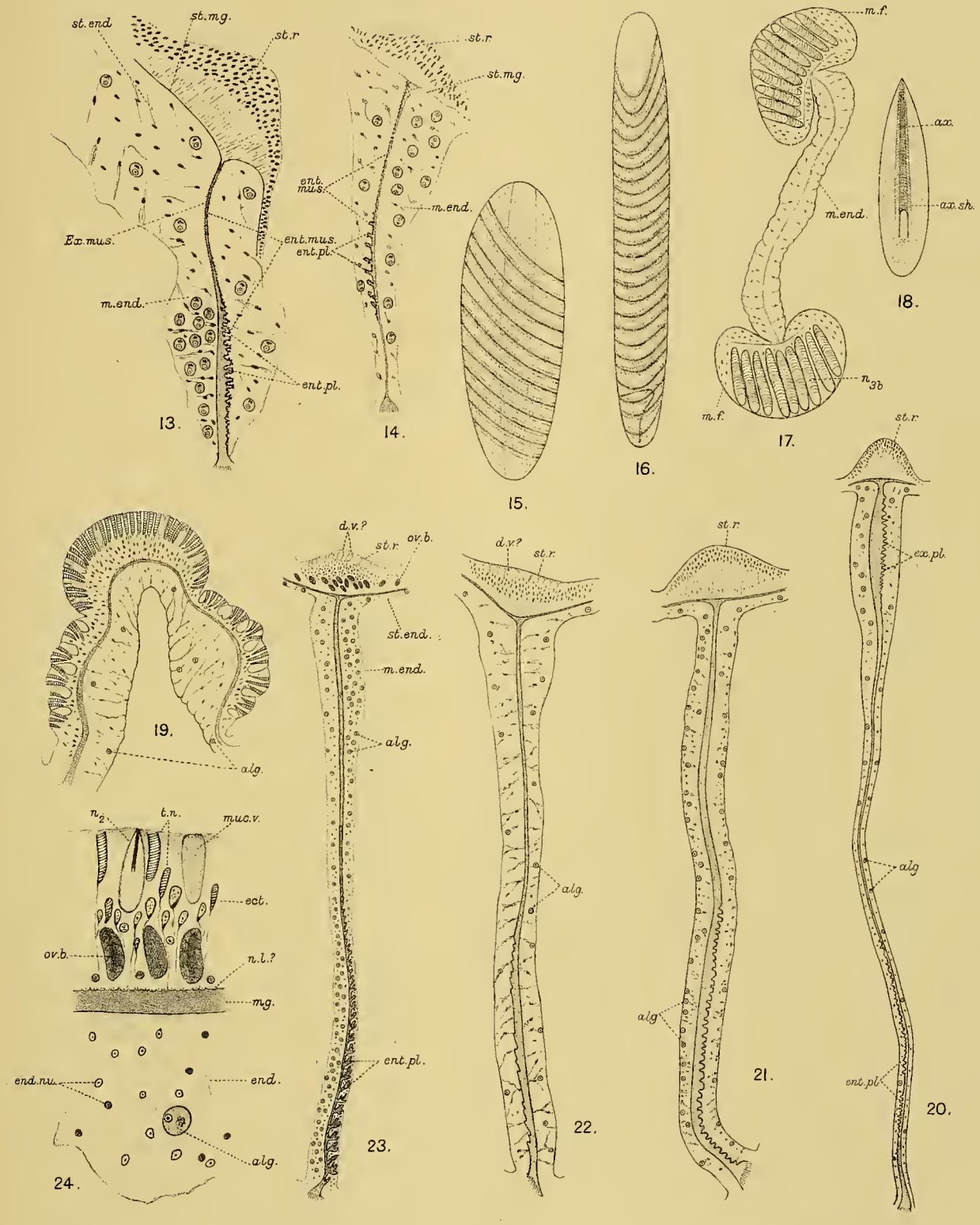

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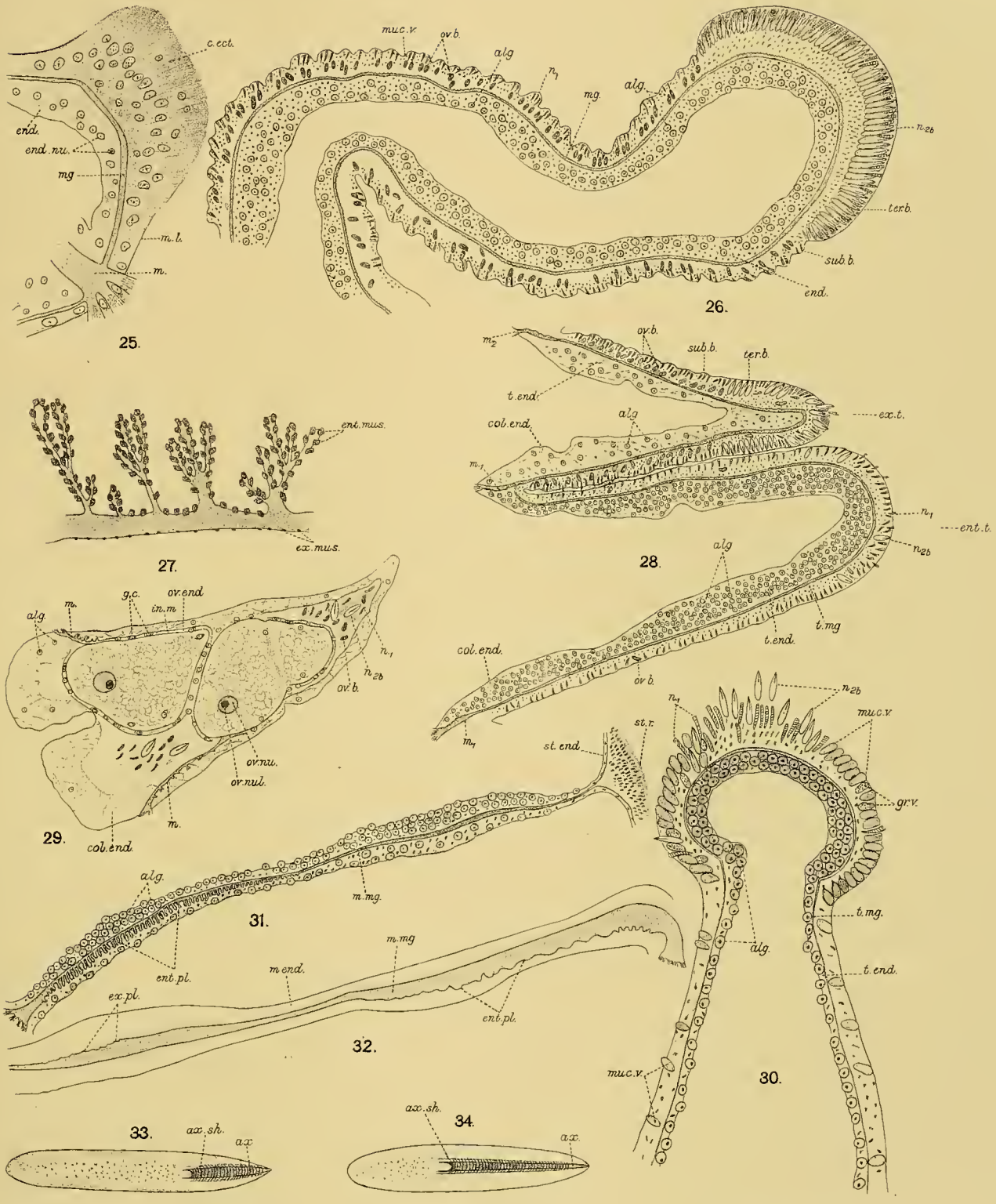

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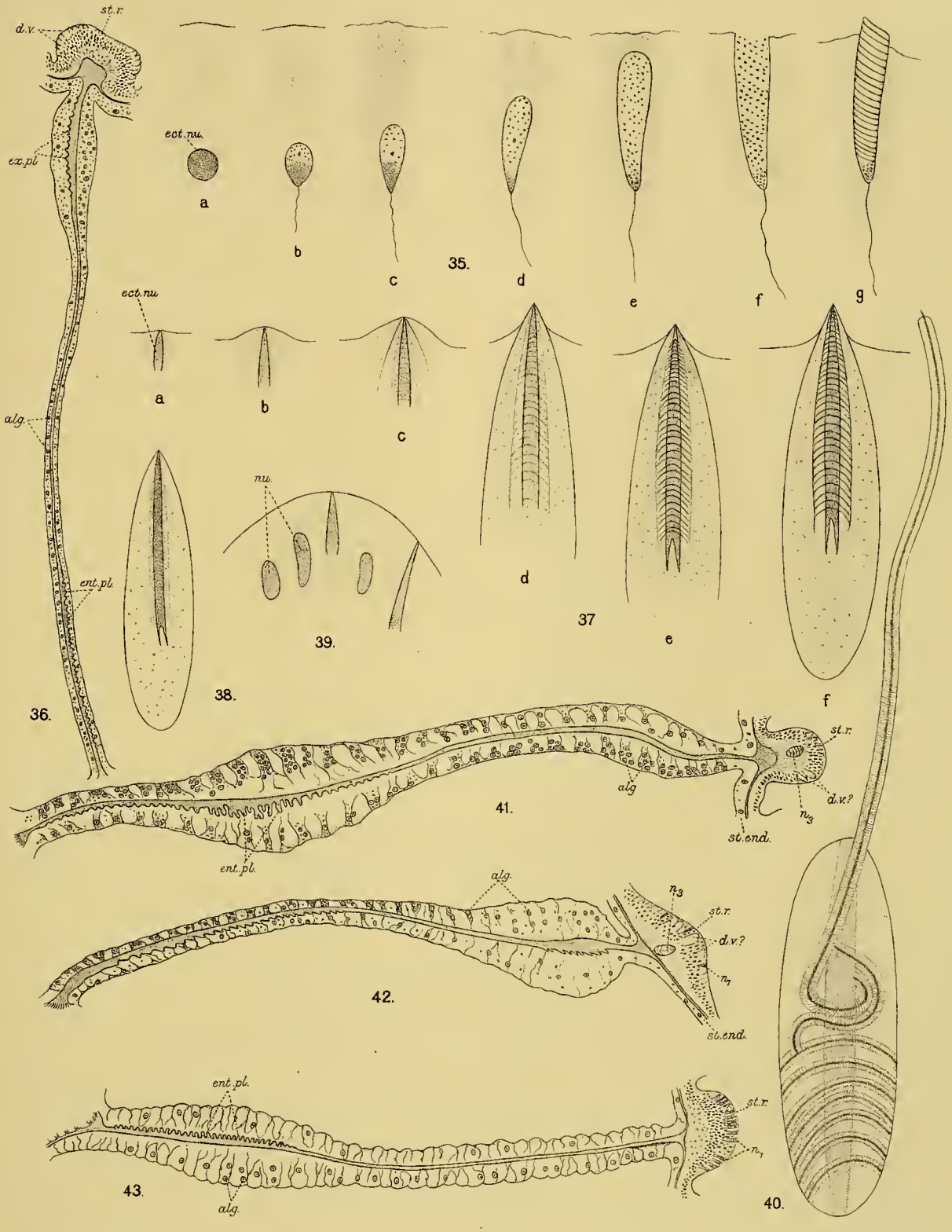

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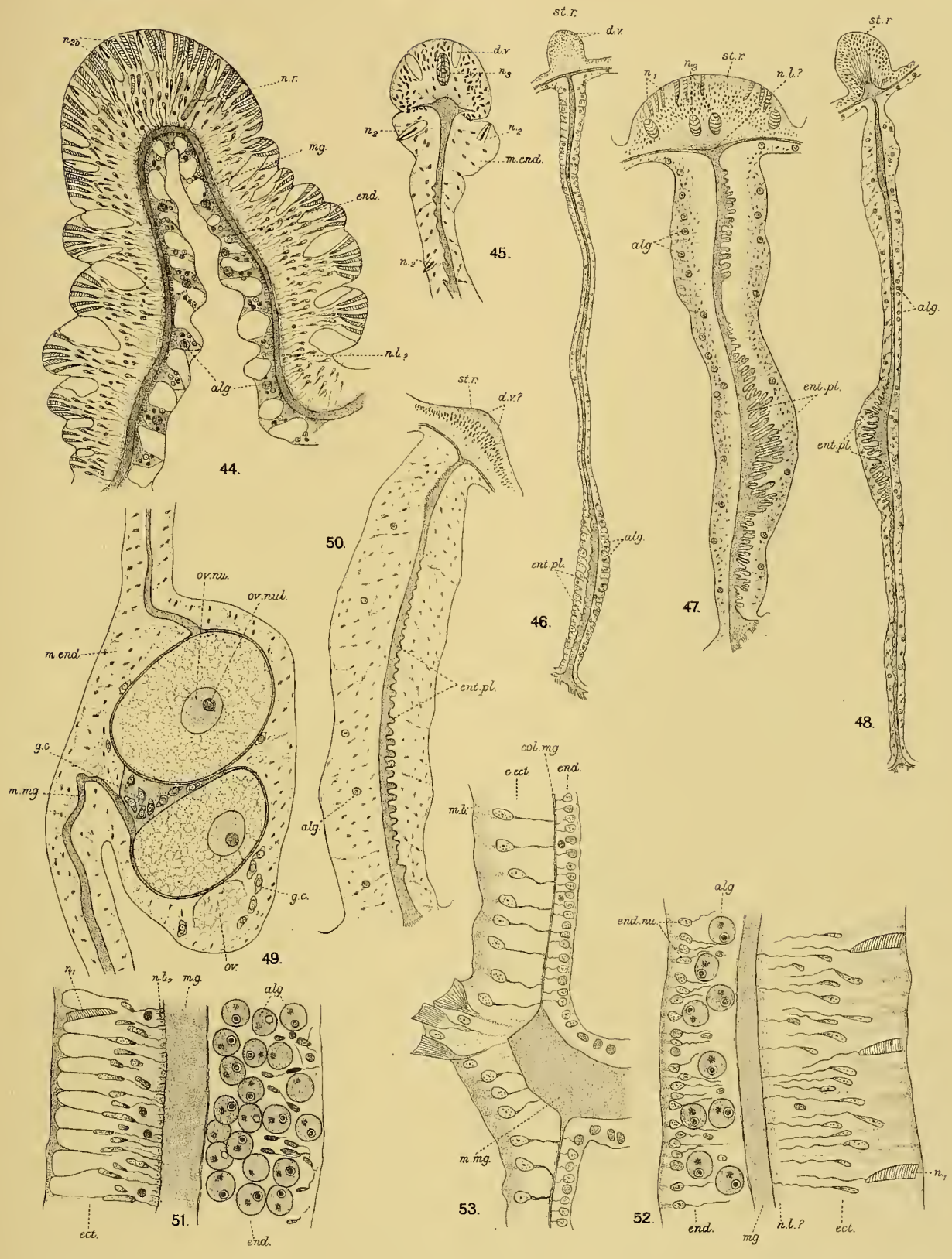

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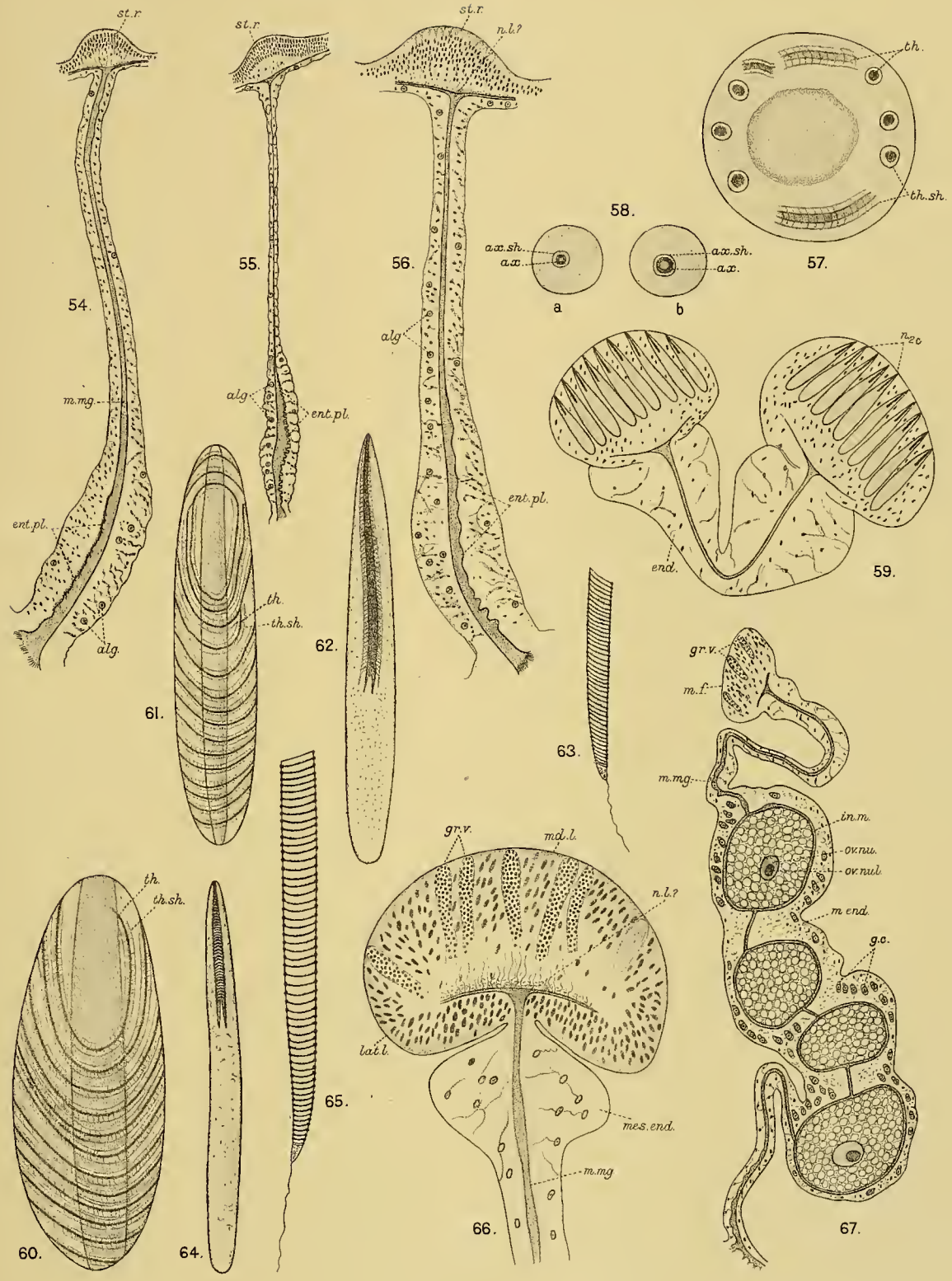

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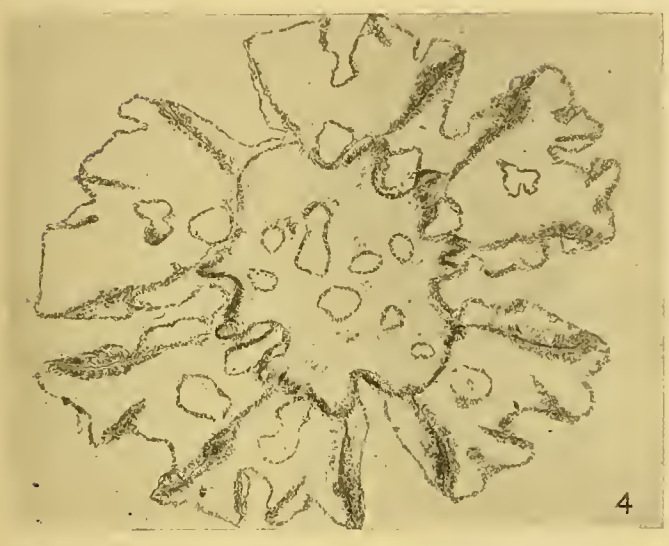

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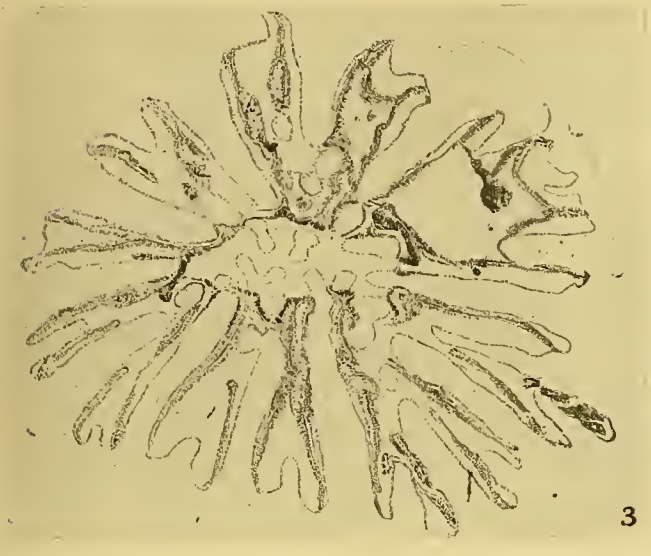
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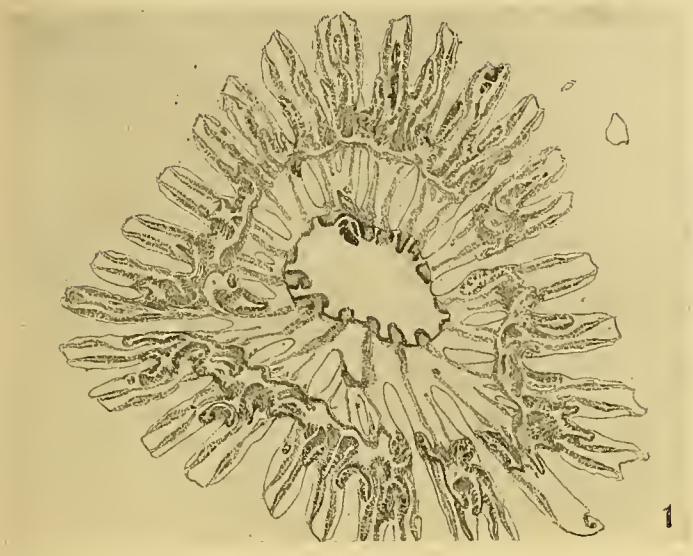
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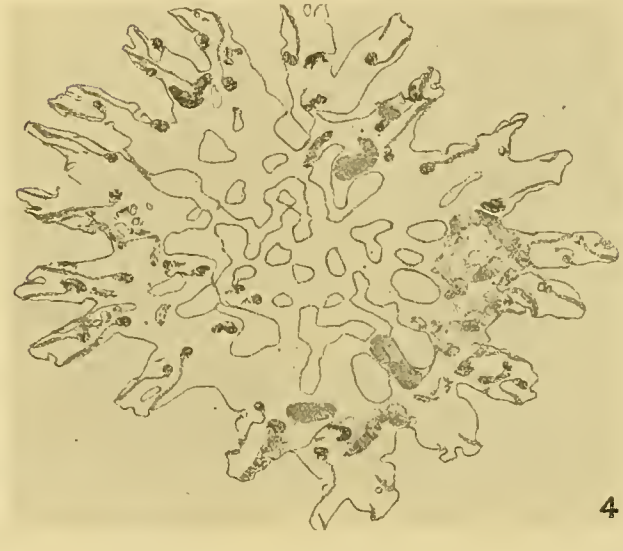
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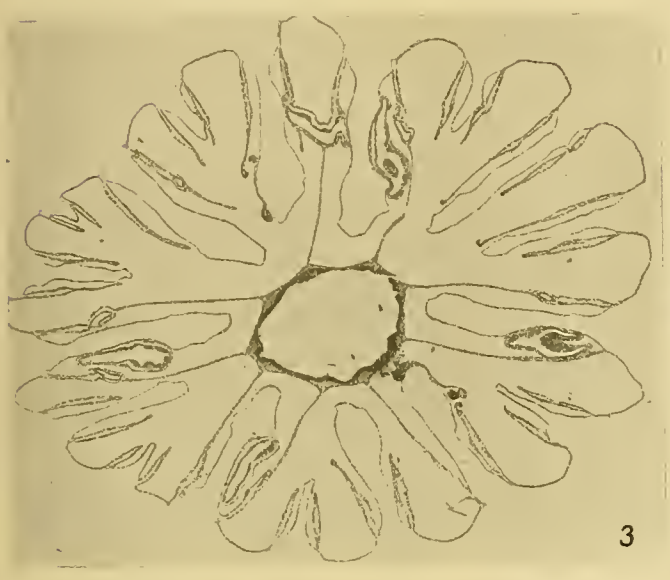
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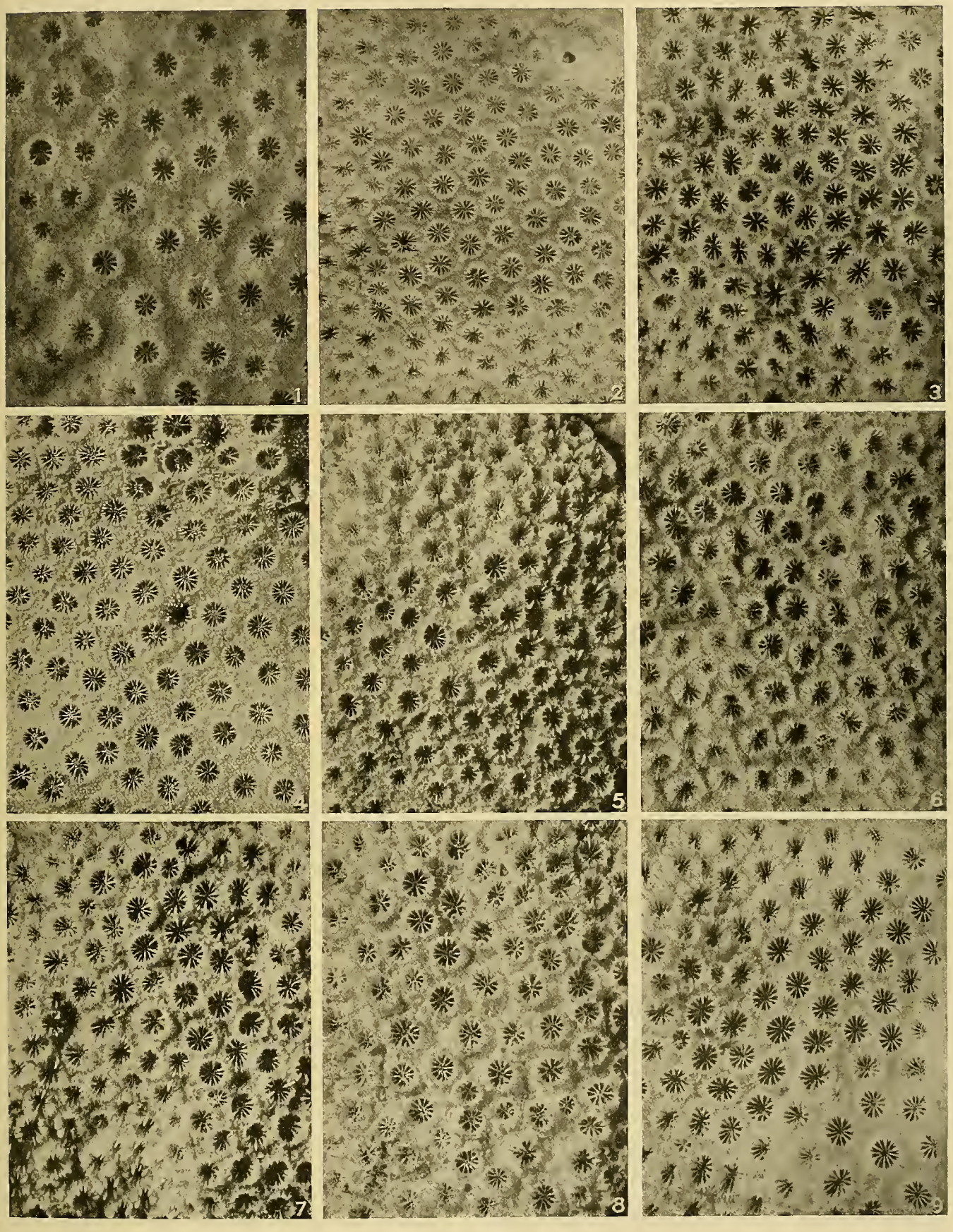
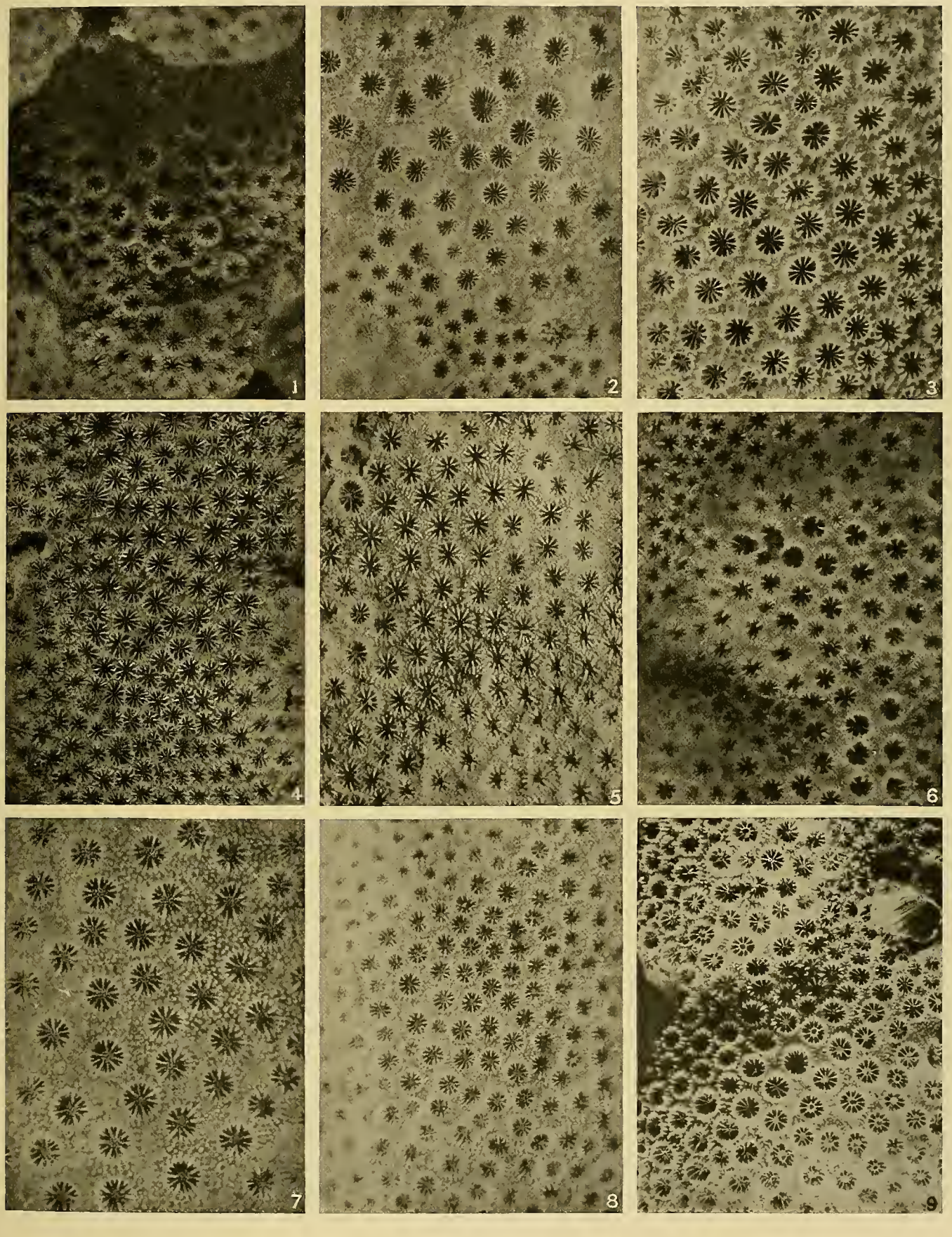


CYPHASTREA SERAILIA



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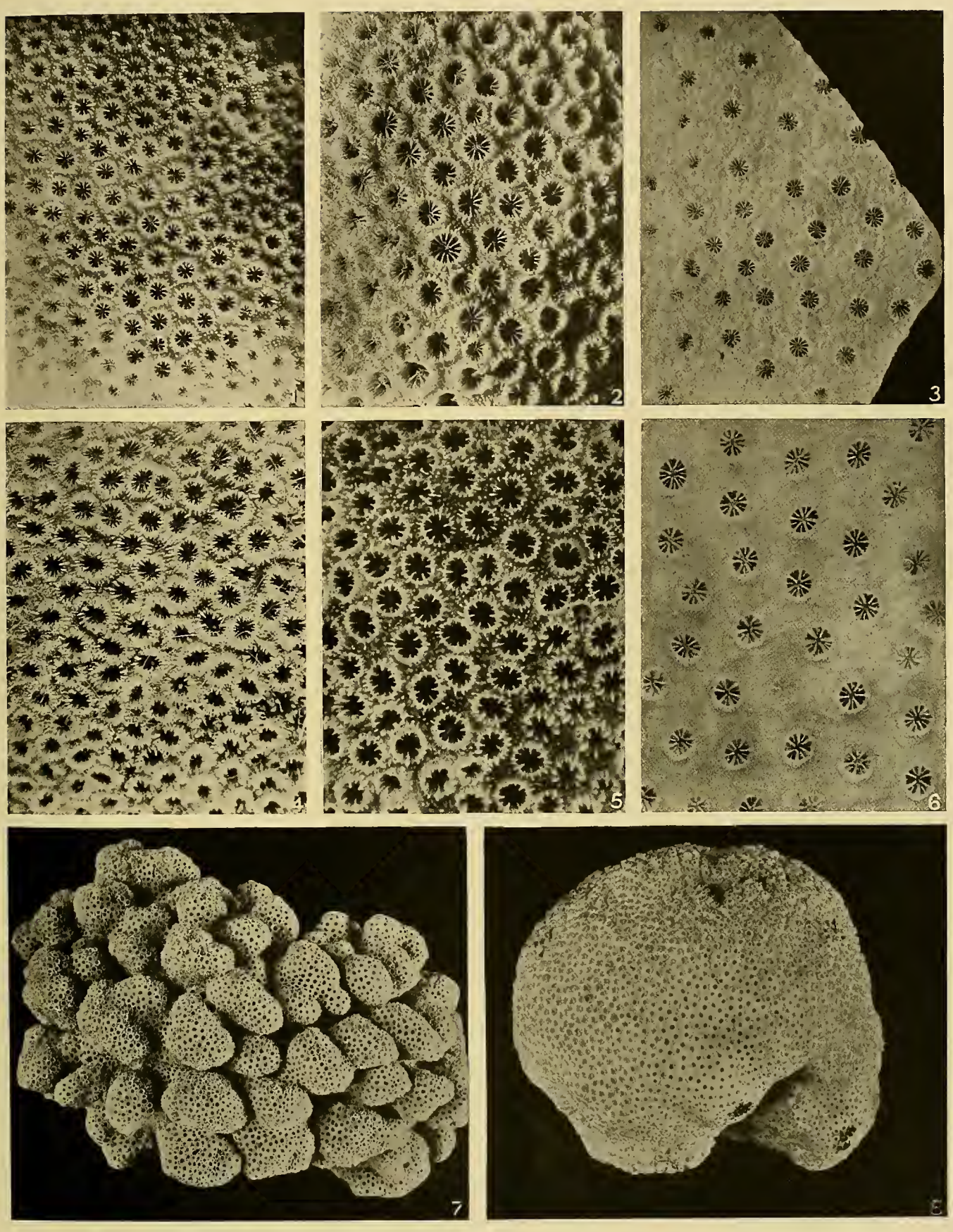
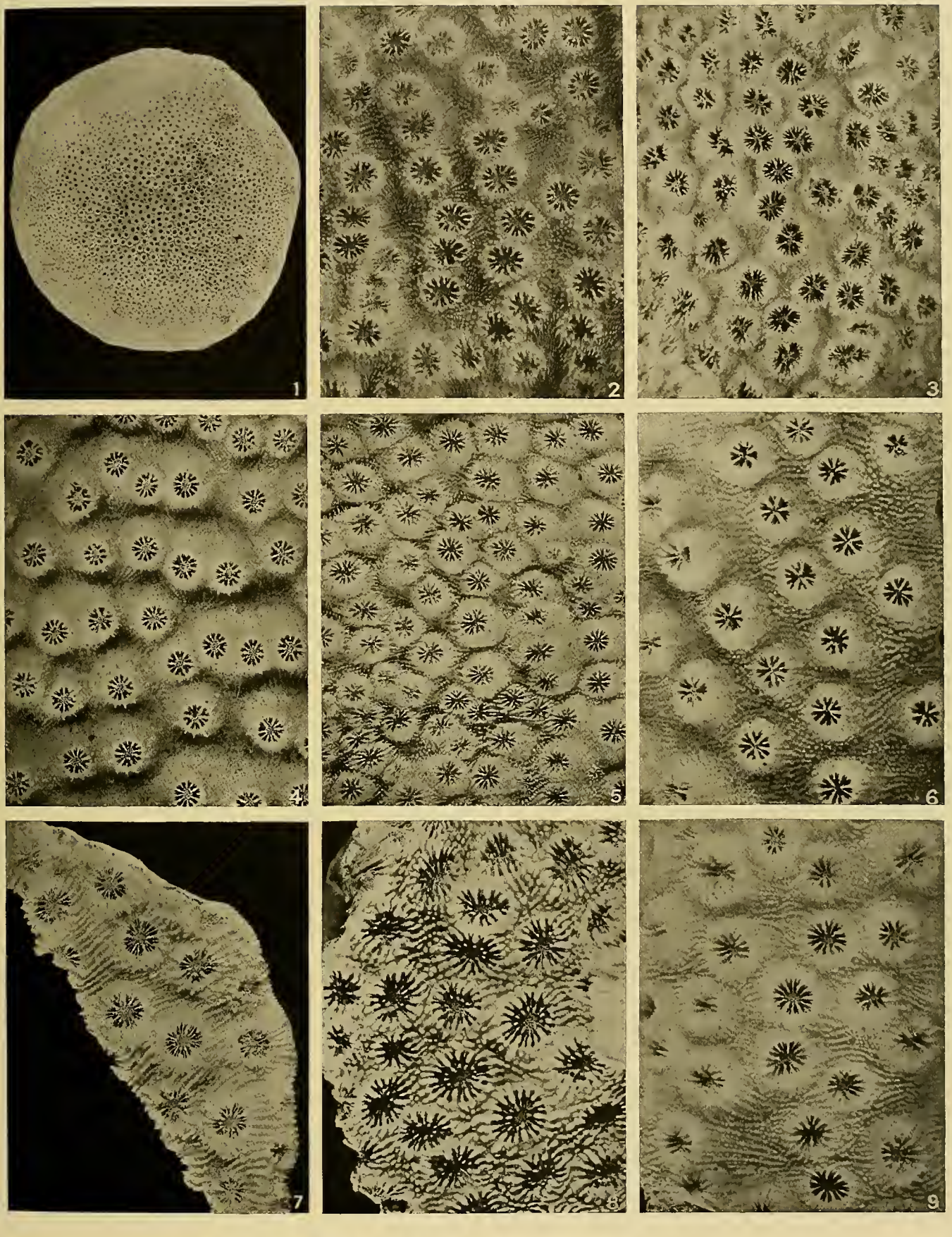
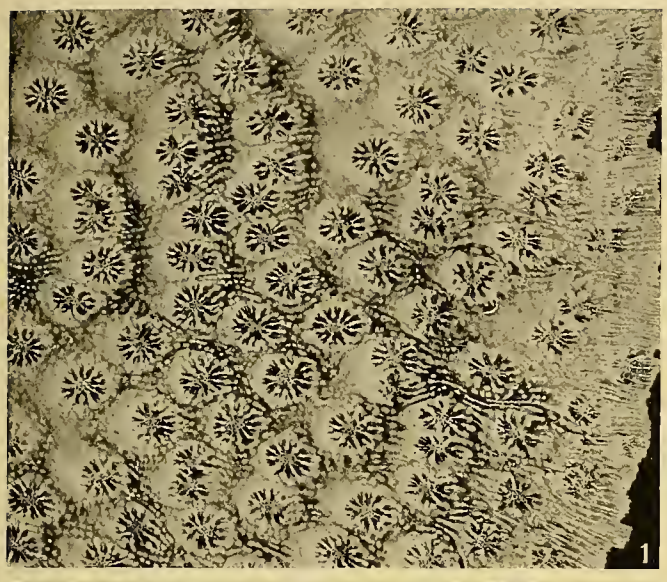
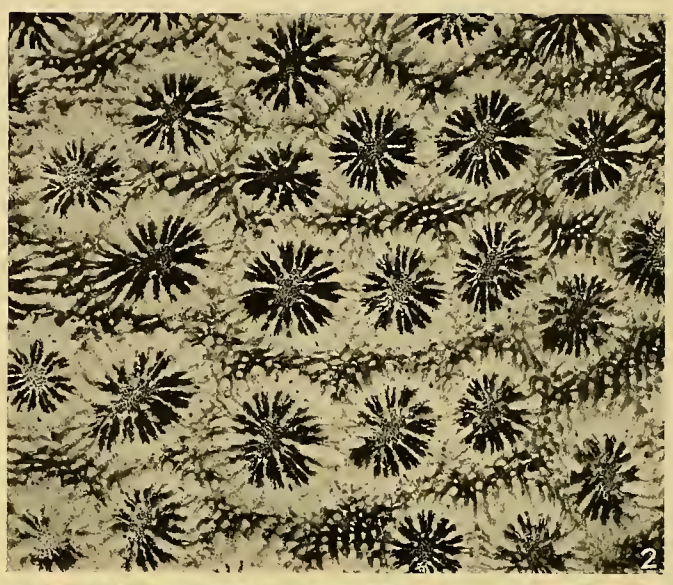


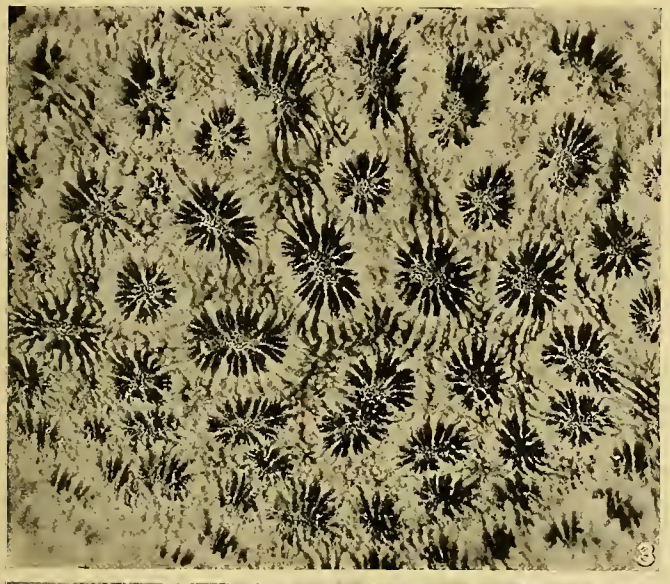
CYPHASTREA 1—5, 7, 8; GALAXEA 6

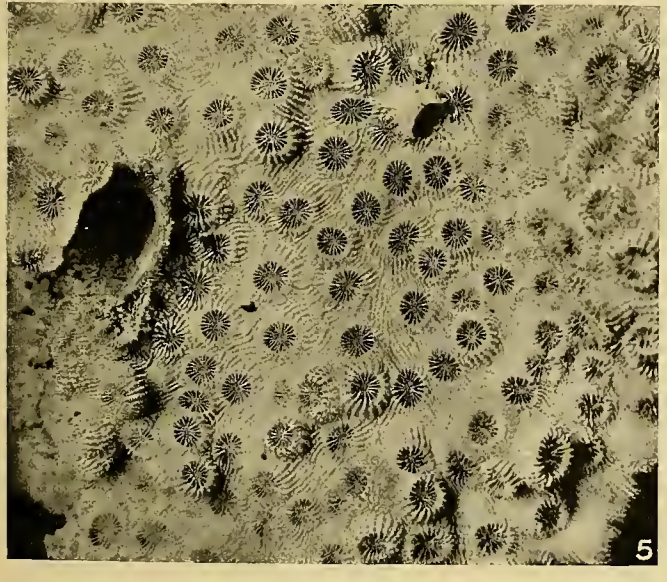


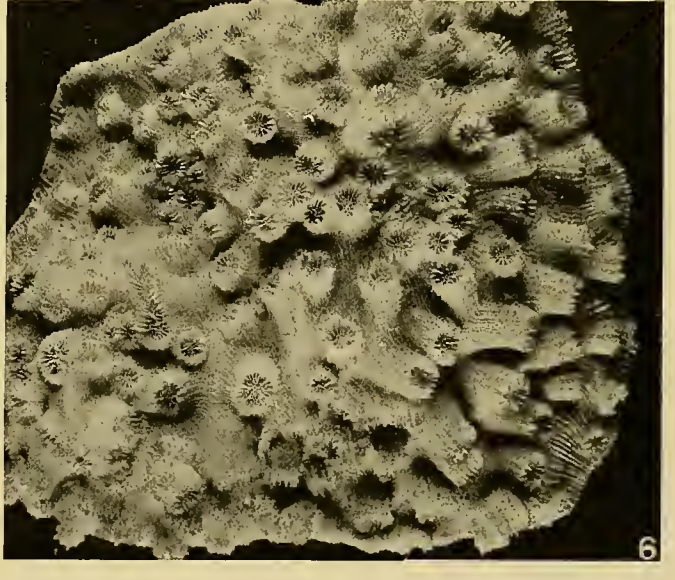
CYPHASTREA 1; ECHINOPORA 2—9











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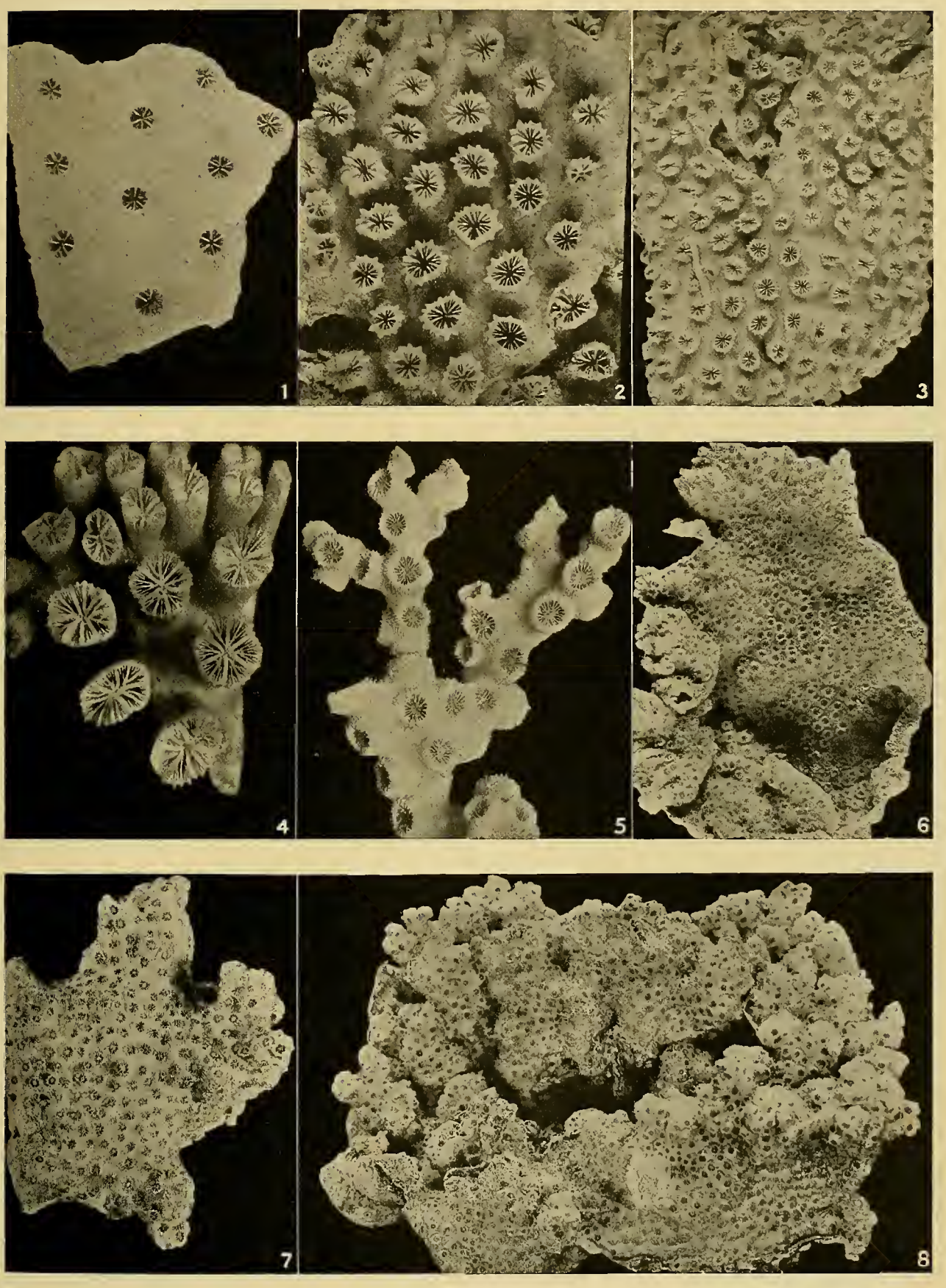
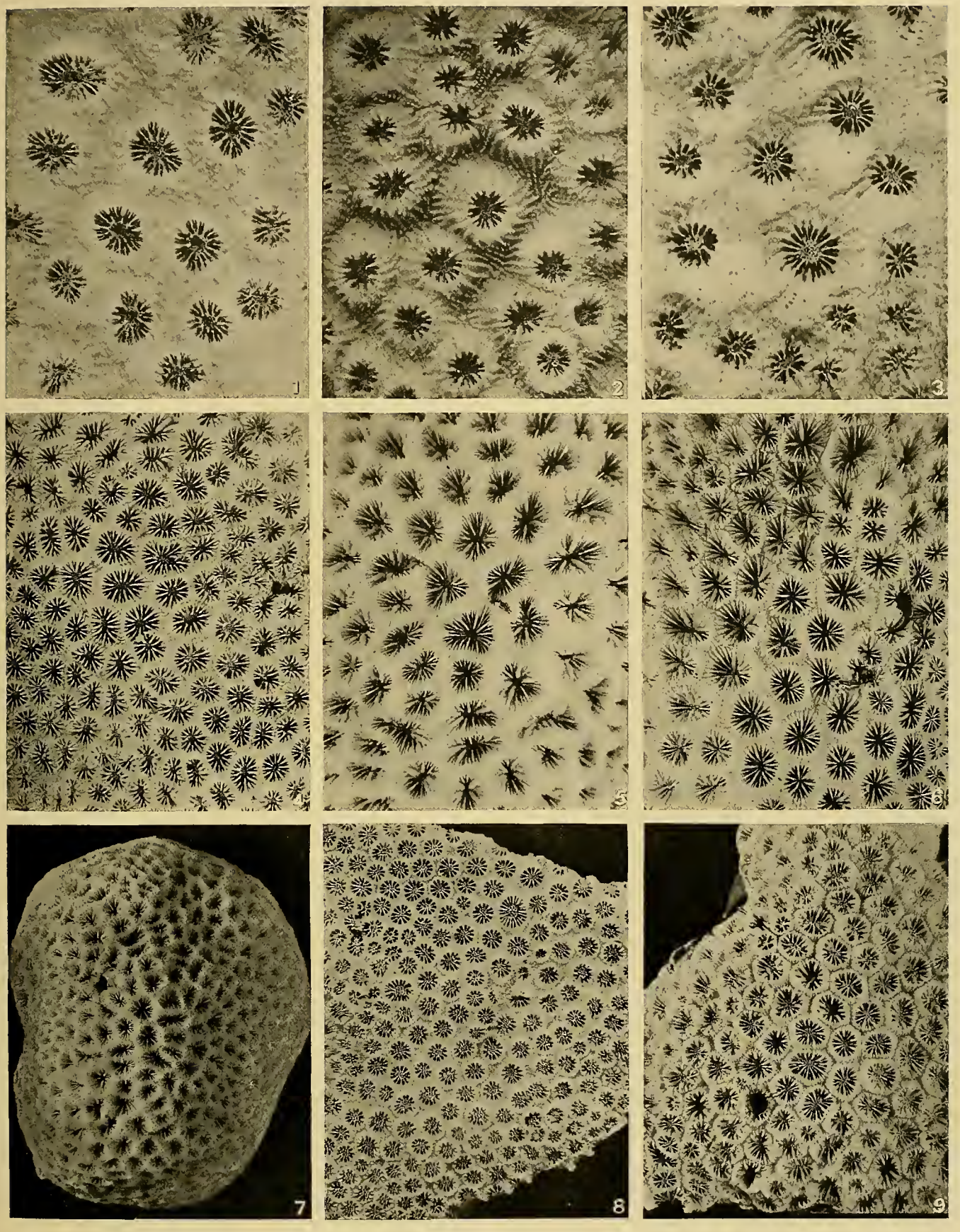
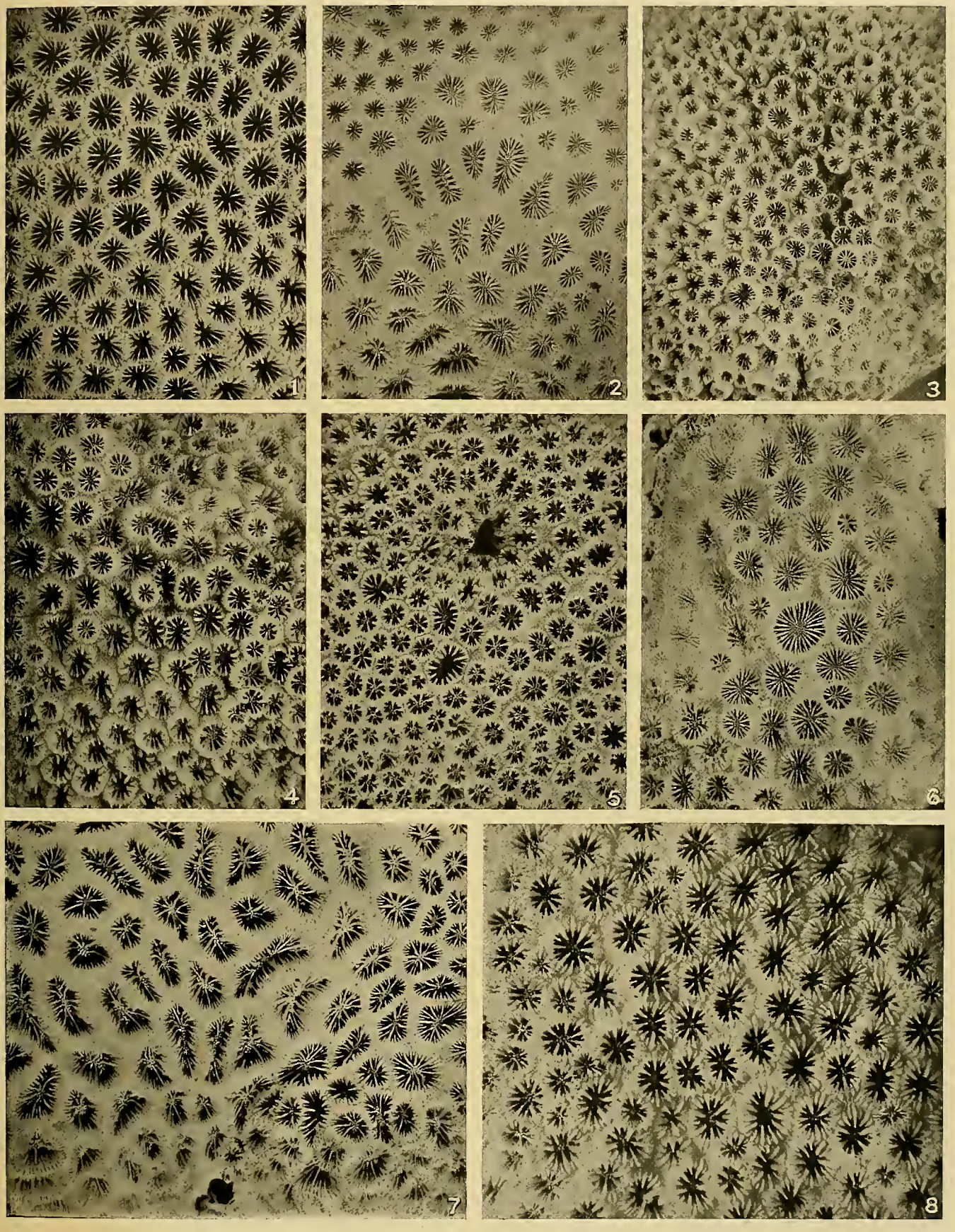


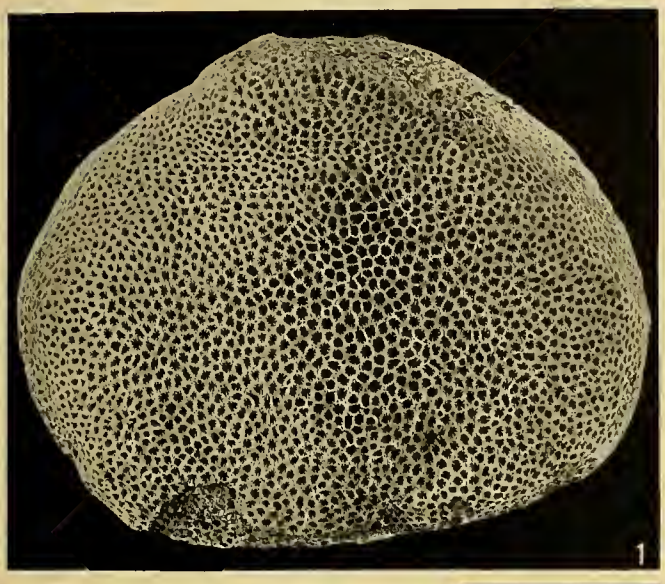
GALAXEA 1–4; ECHINOPORA 5–8

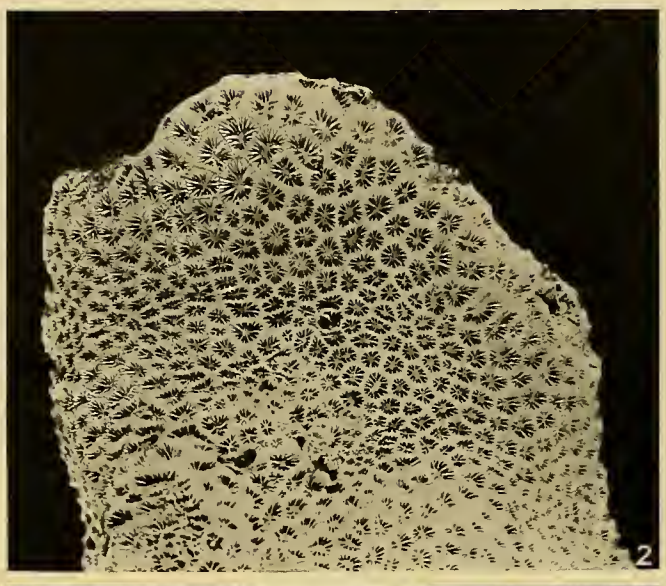


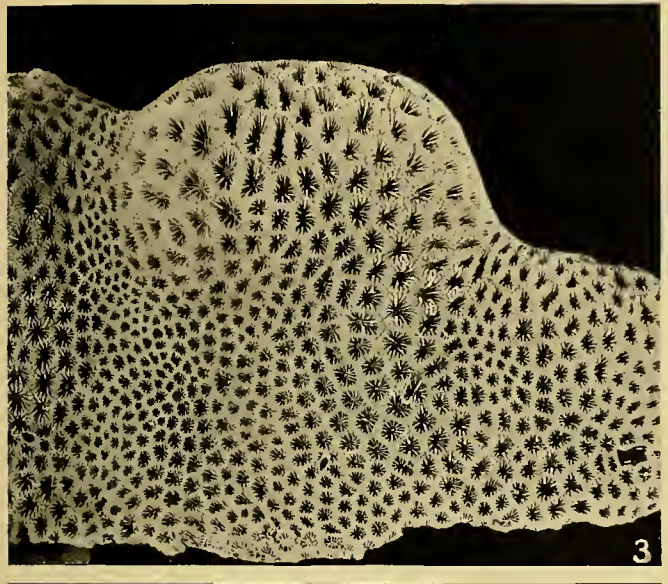
ECHINOPORA 1—3; LEPTASTREA 4—9

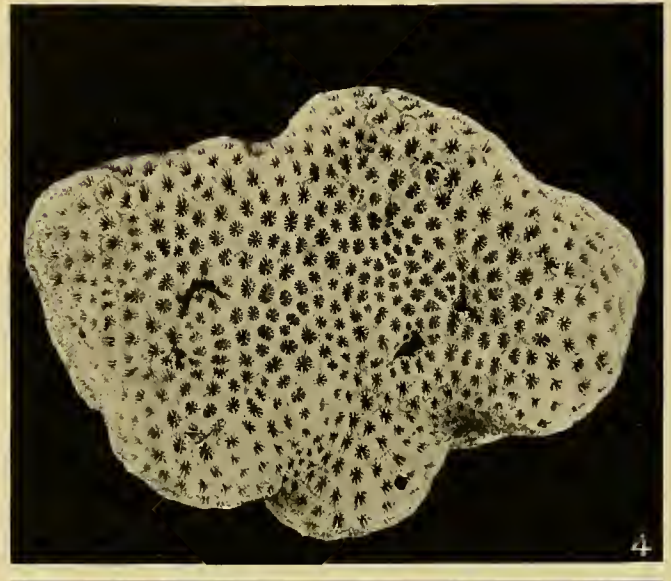


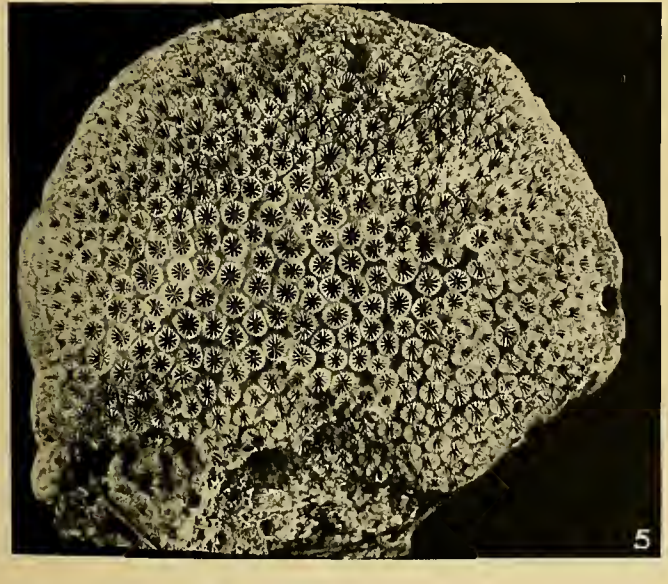
LEPTASTREA

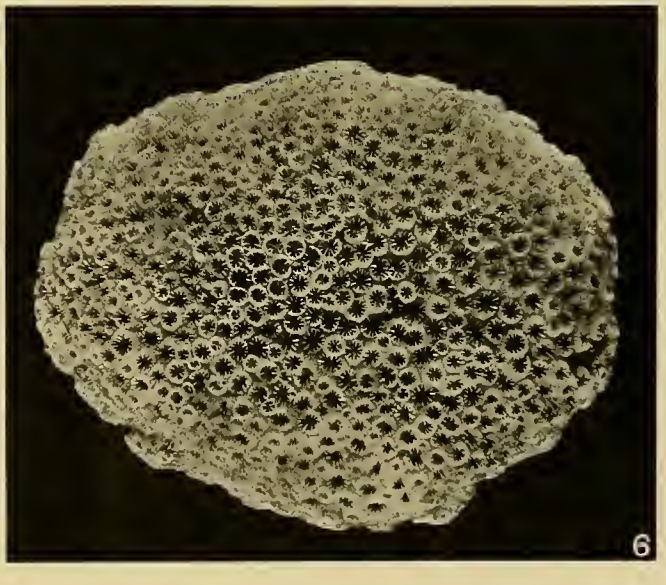




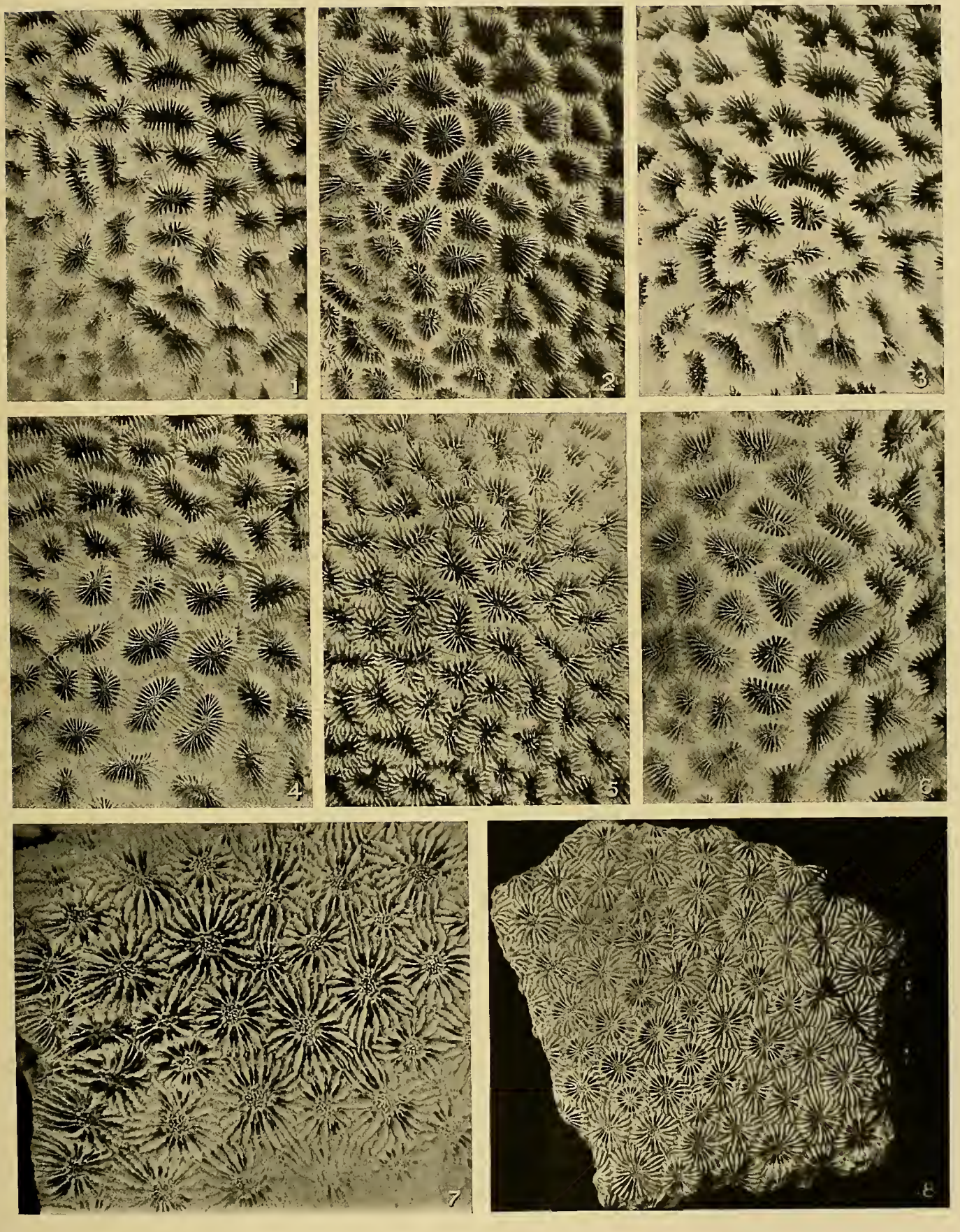




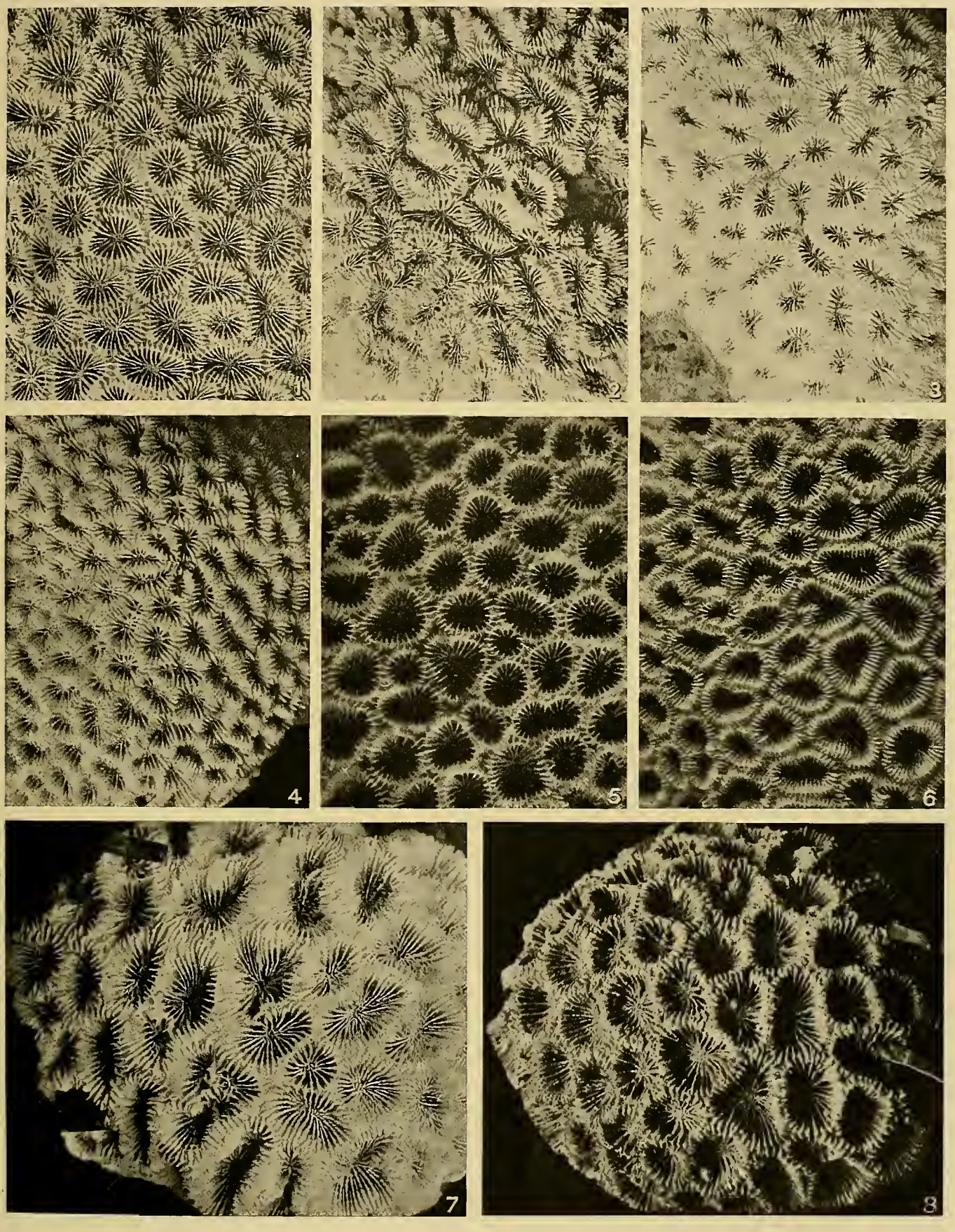




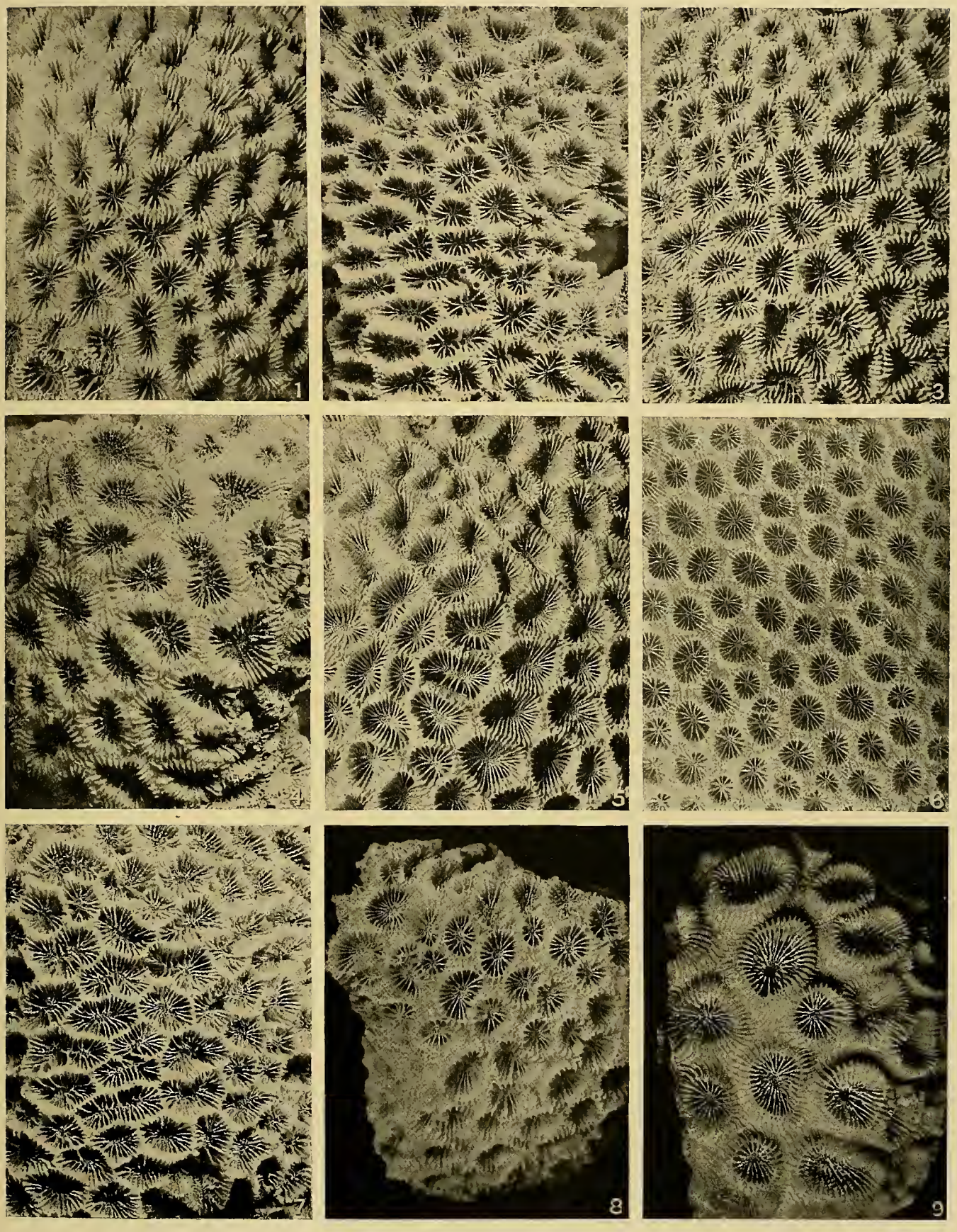
LEPTASTREA



FAVIA 1—6; DIPLOASTREA 7, 8



FAVIA FAVUS



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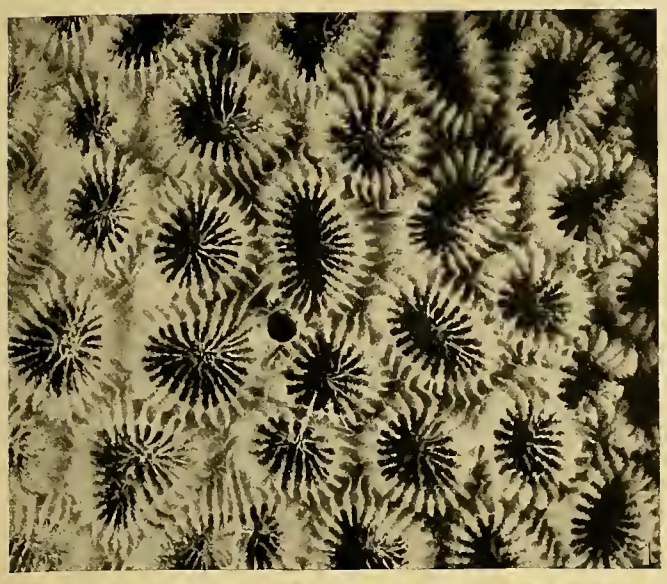

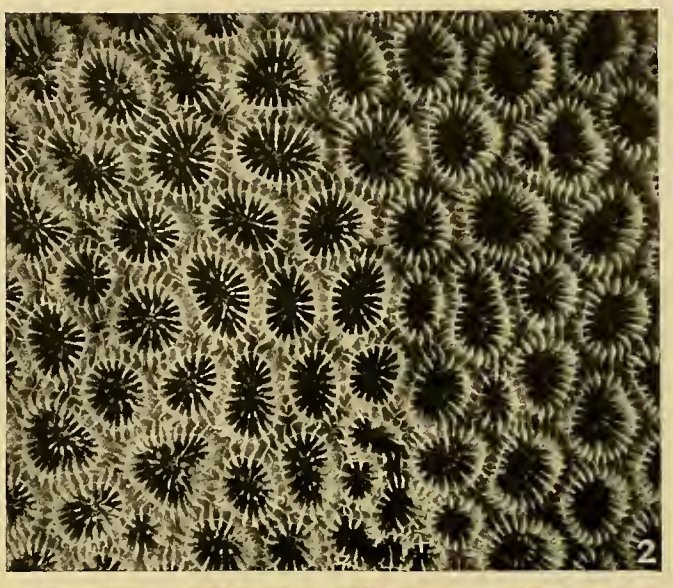

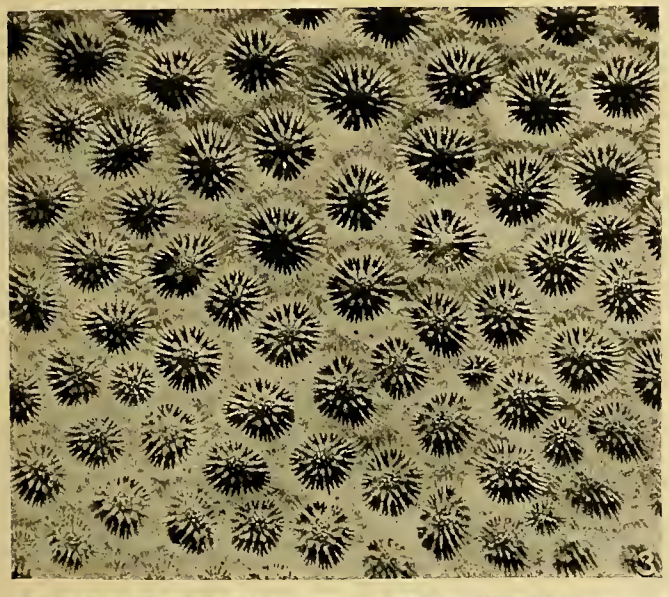

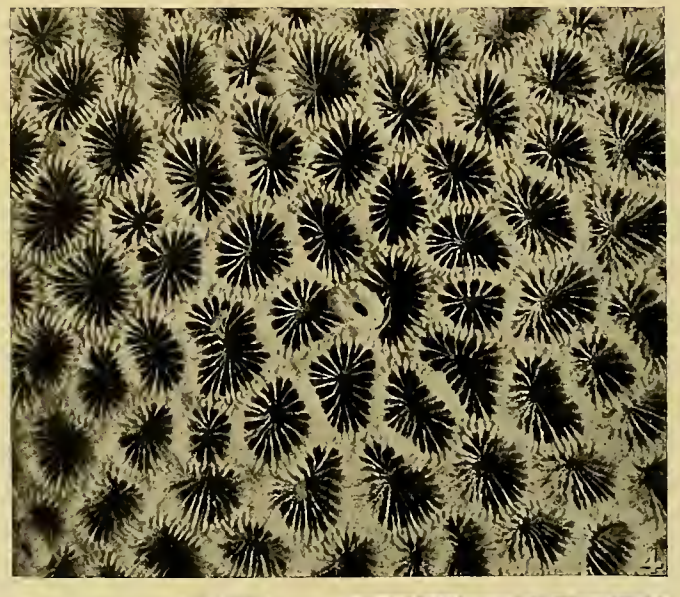

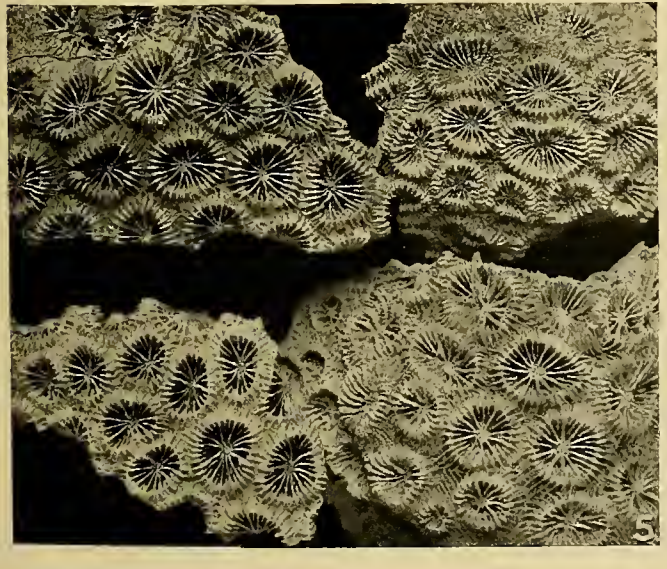

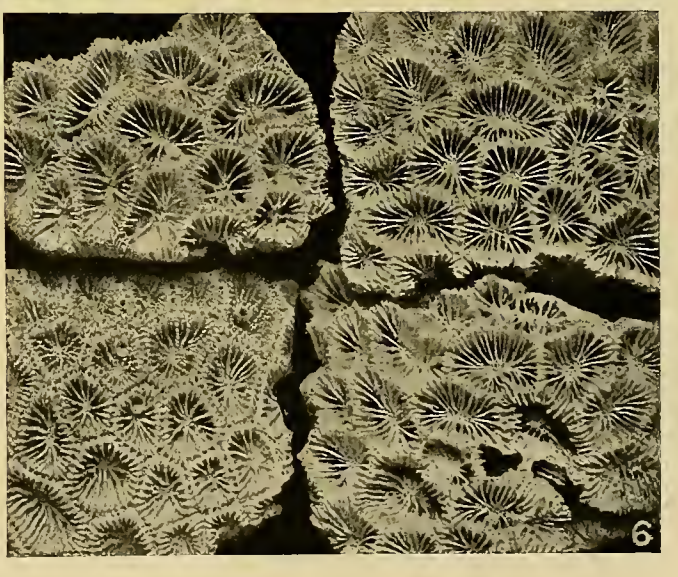

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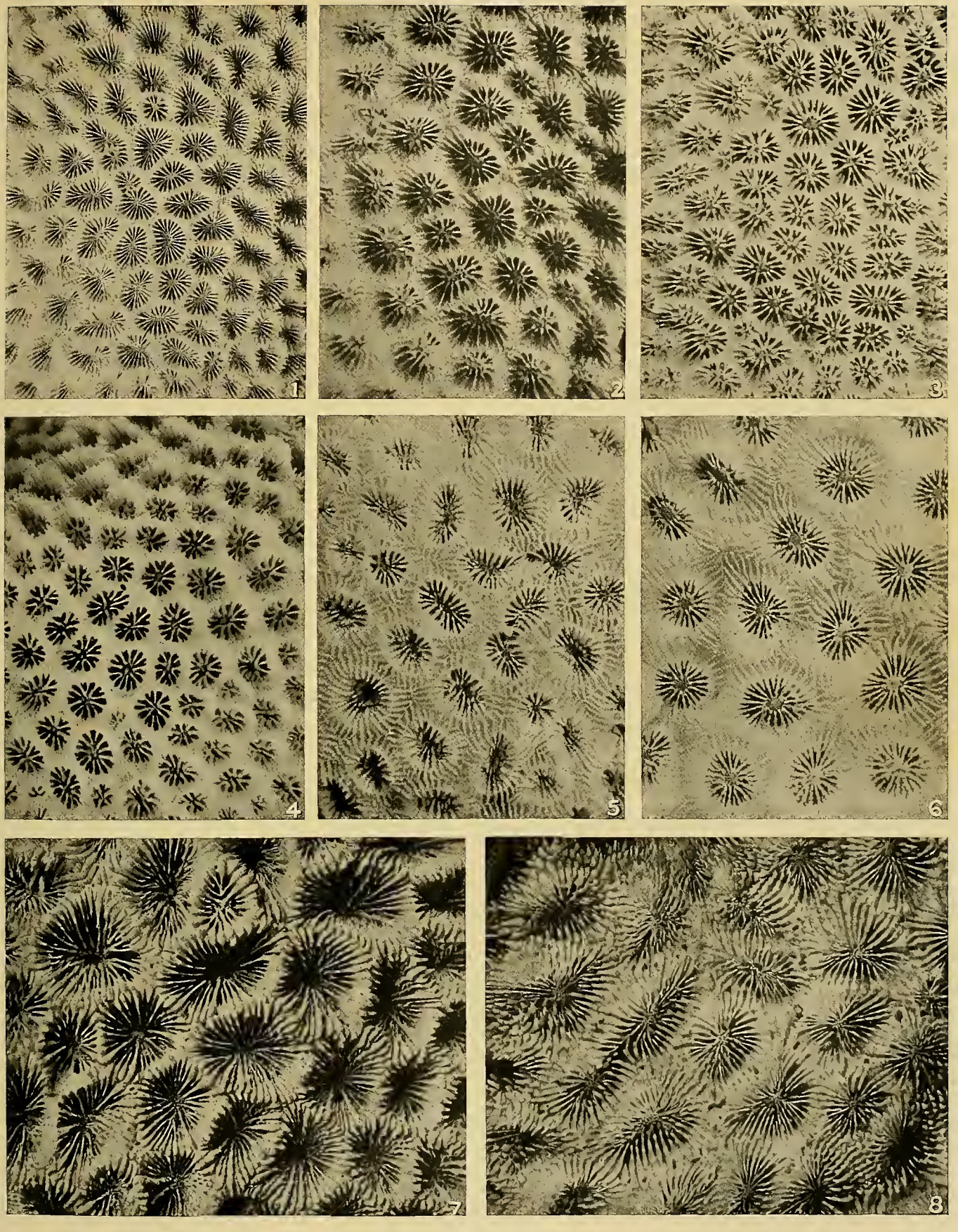

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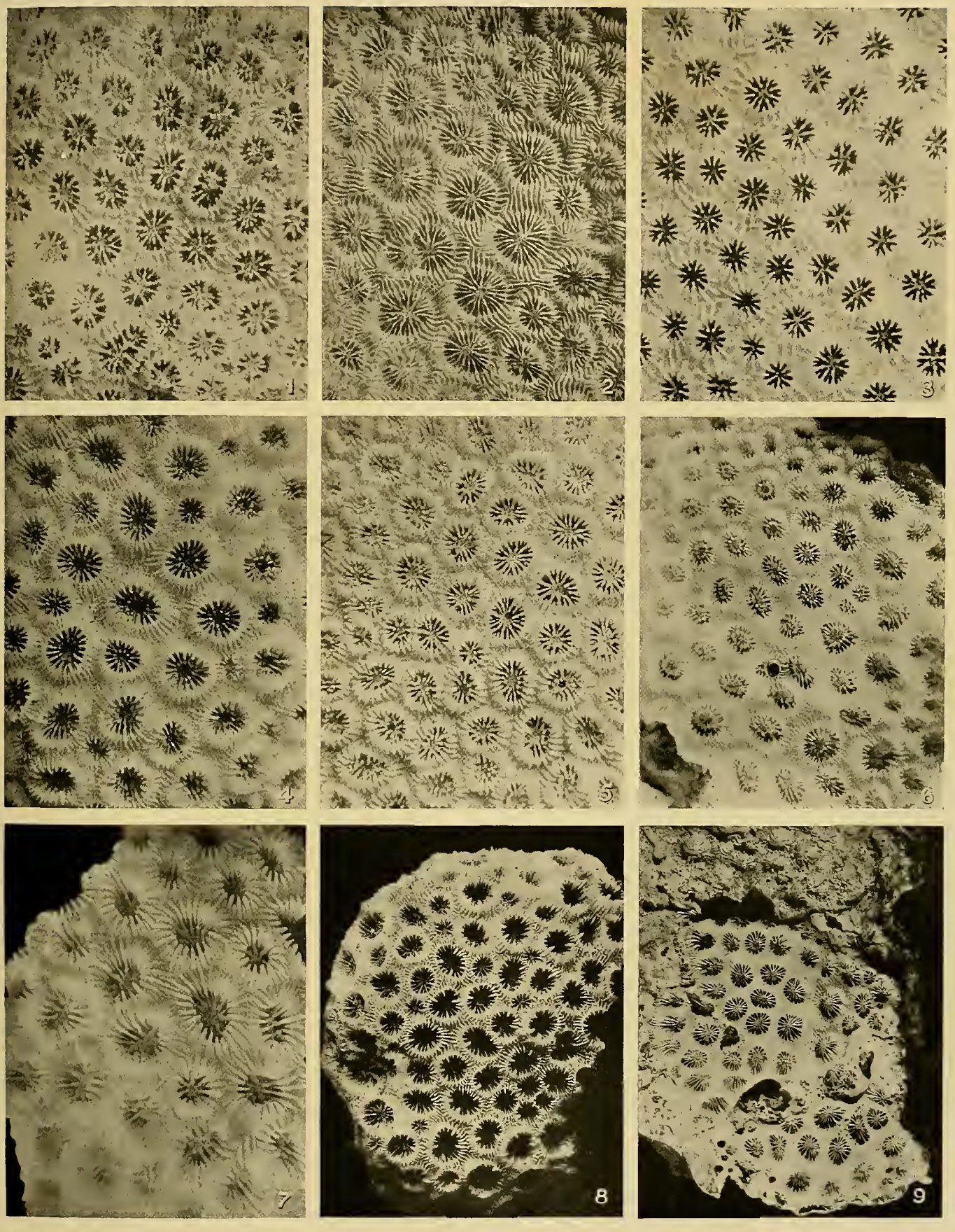

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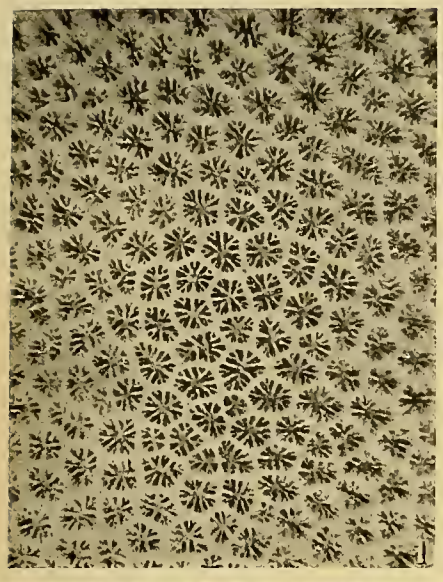

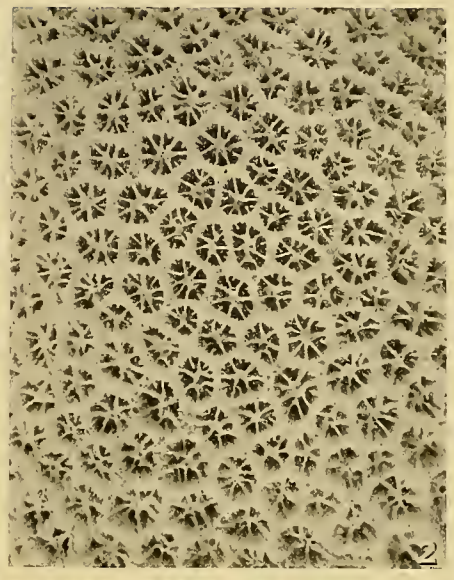

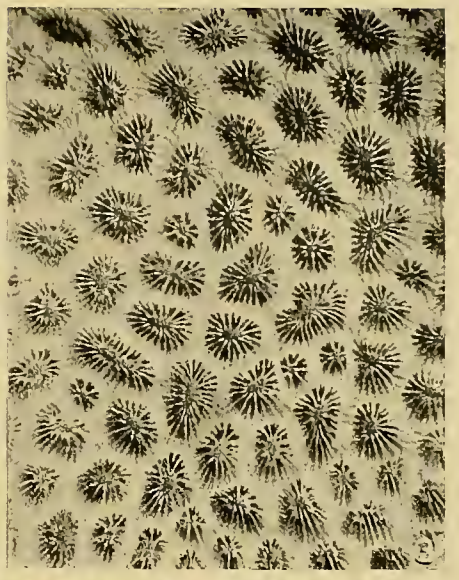

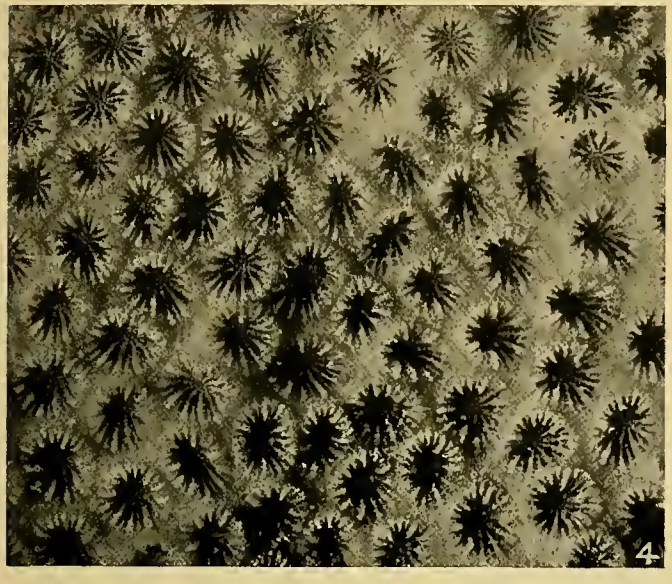

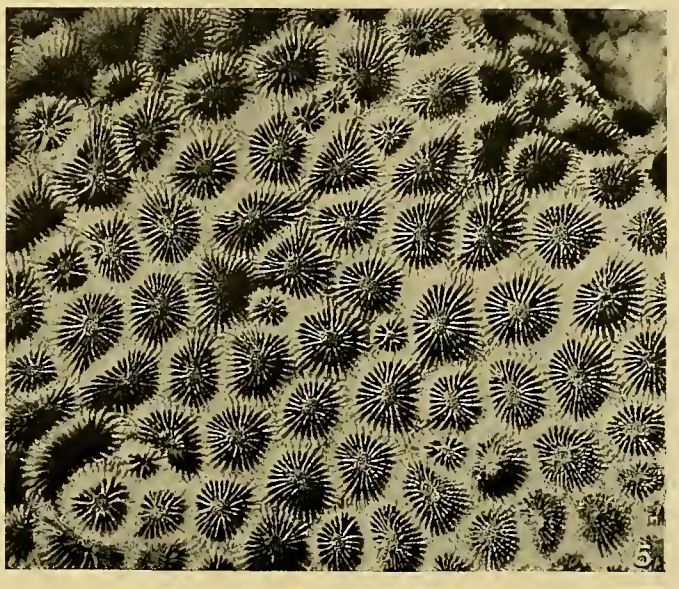

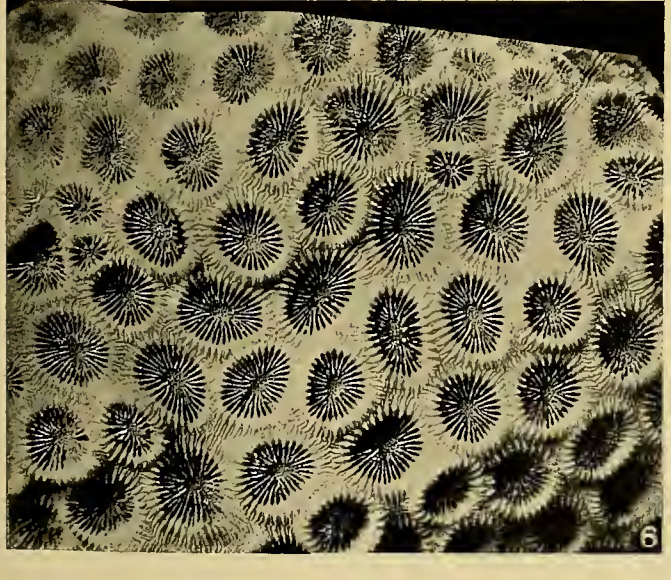

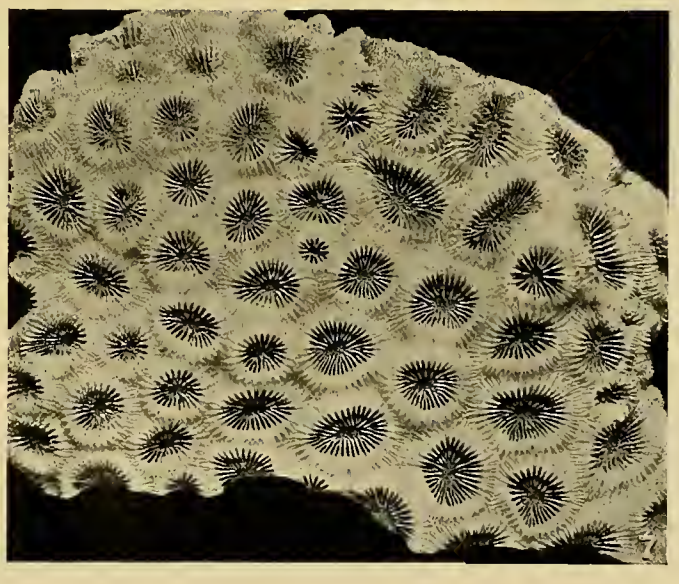

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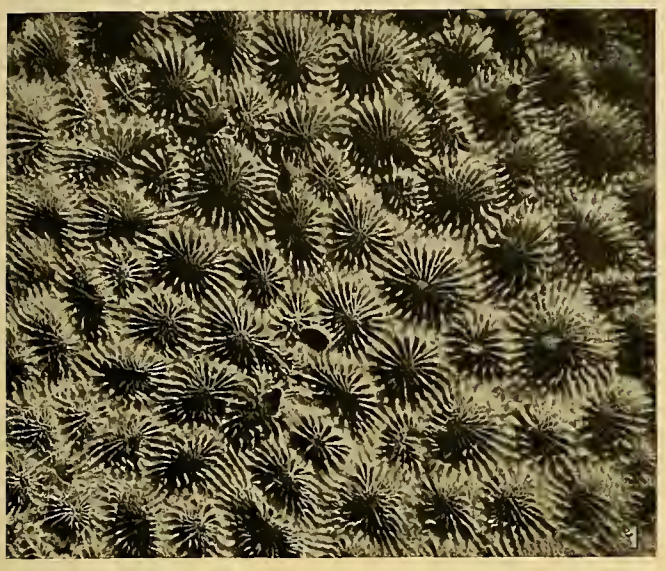

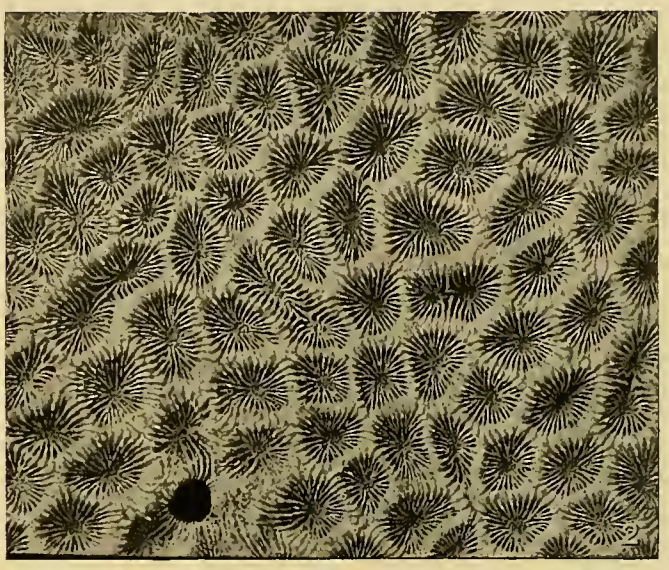

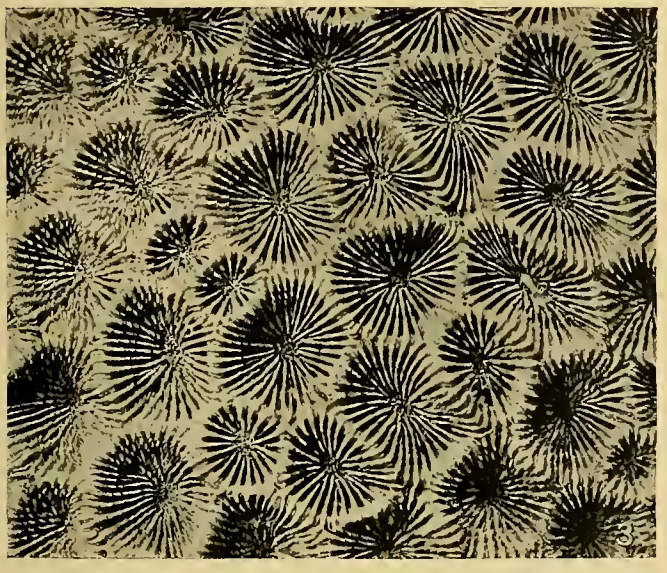

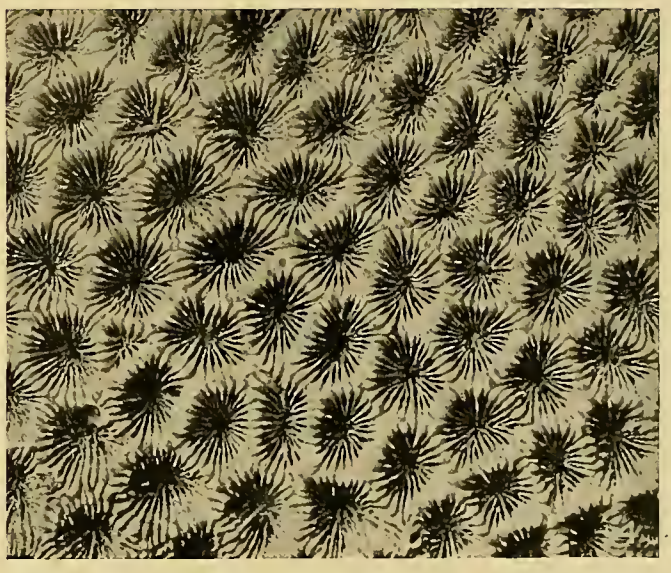

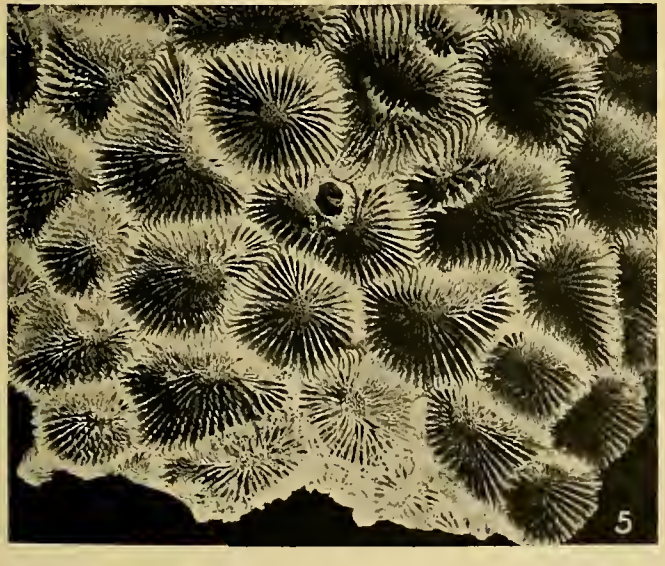

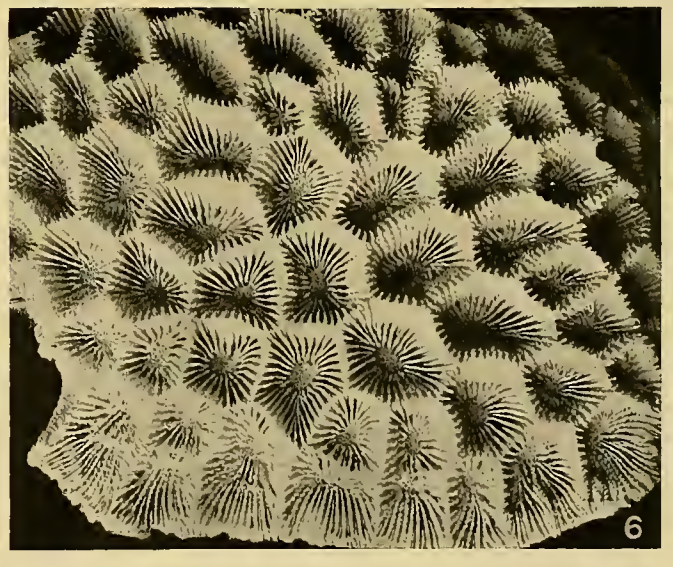

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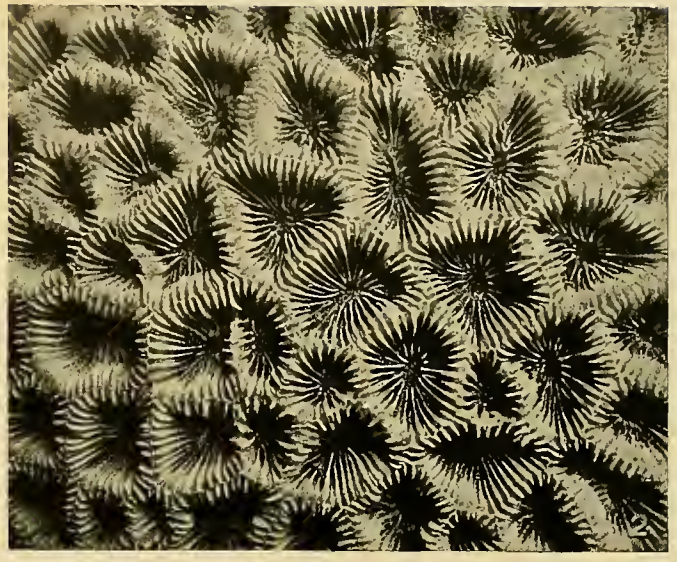
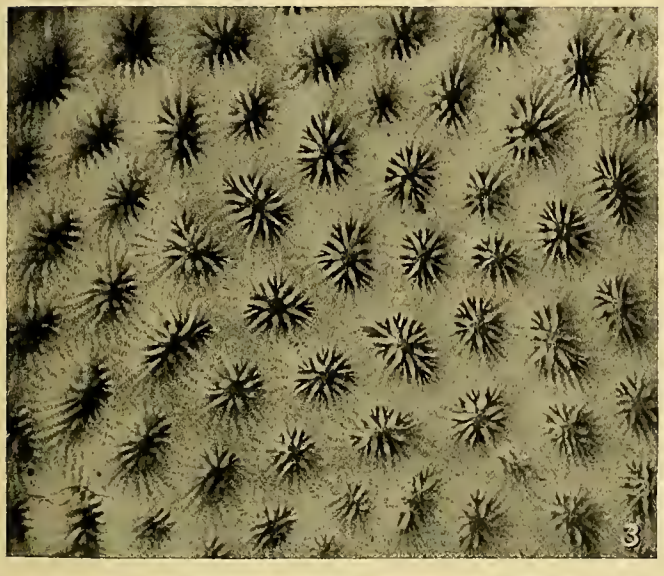
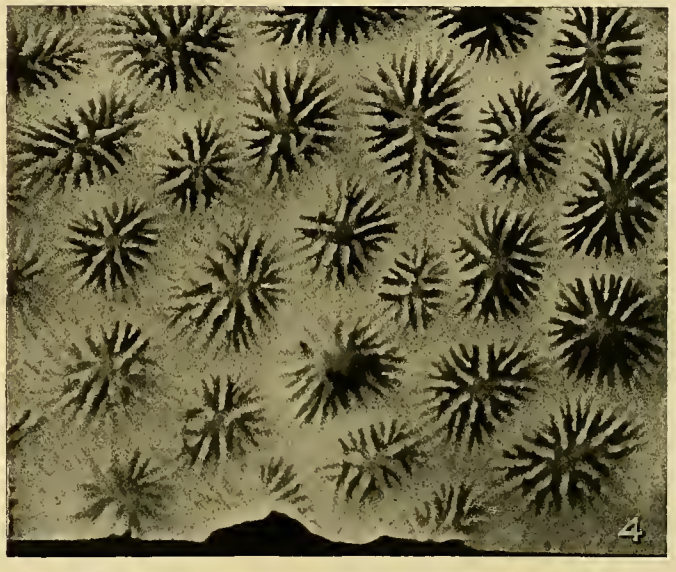
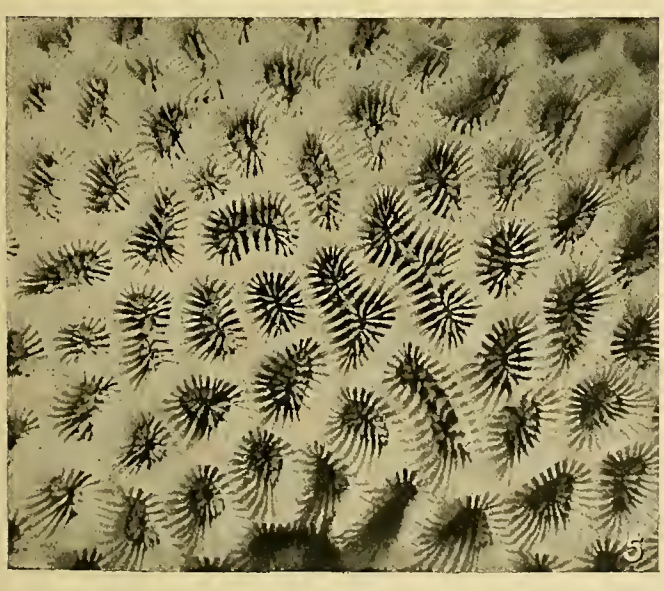
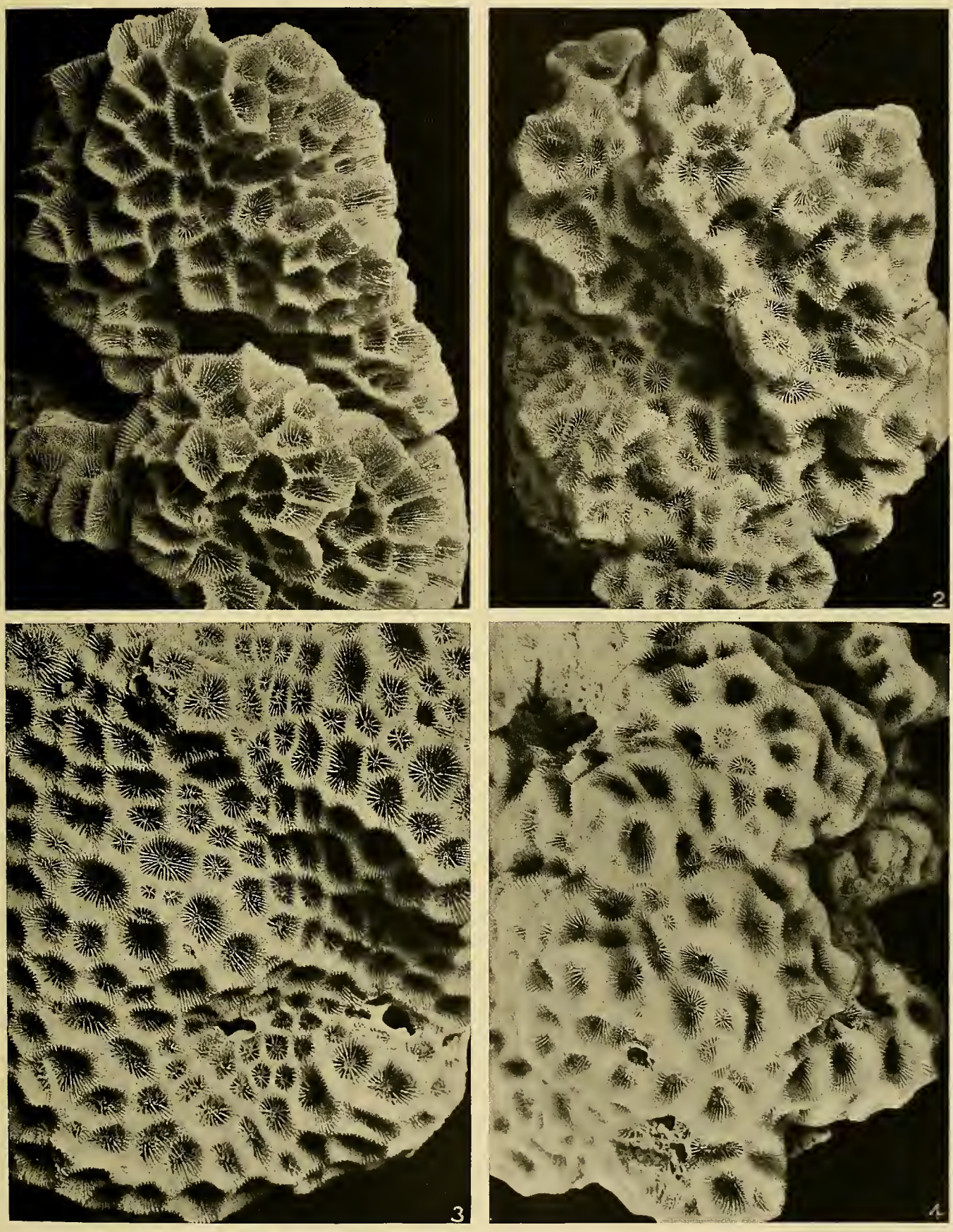








FAVIA 1, 2; GONIASTREA 3—6



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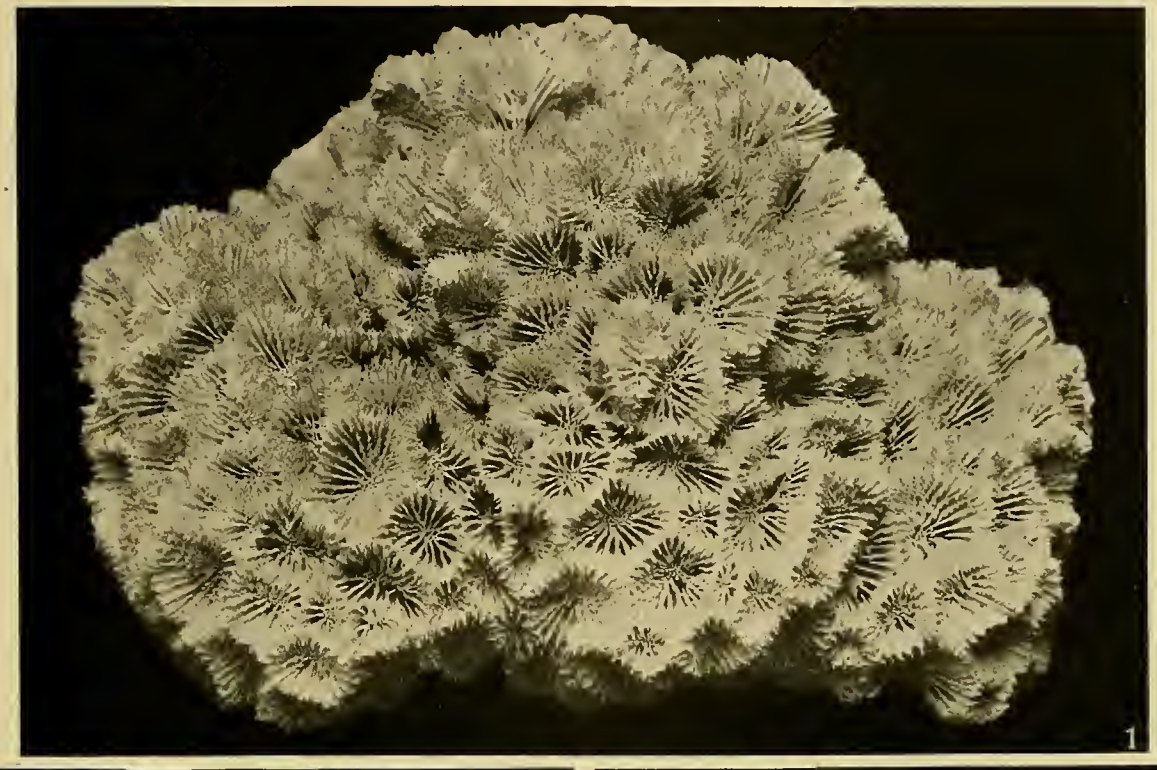
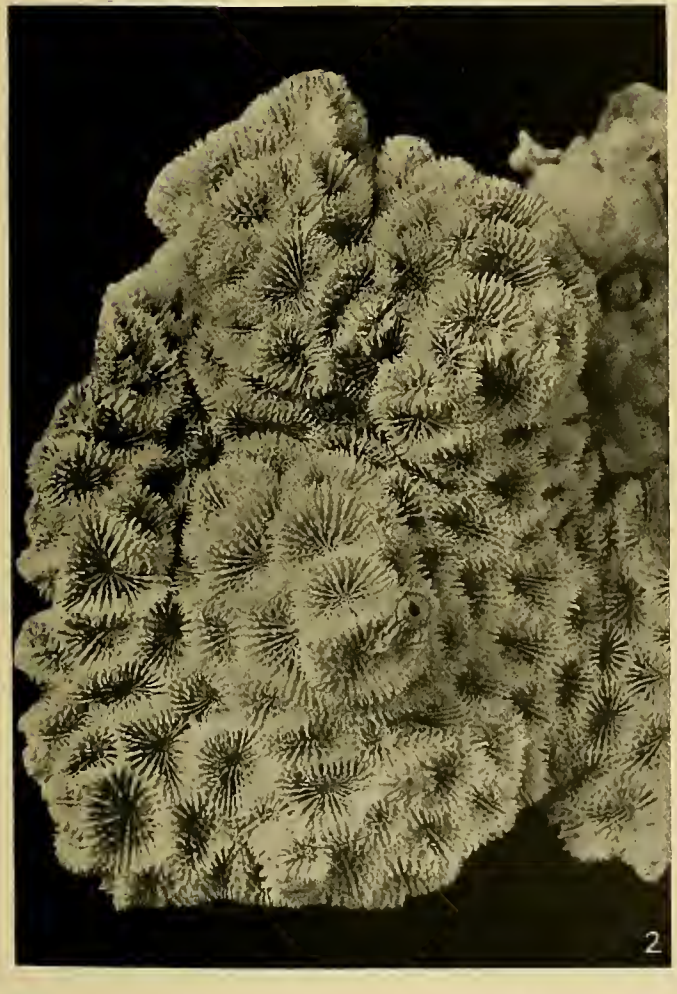
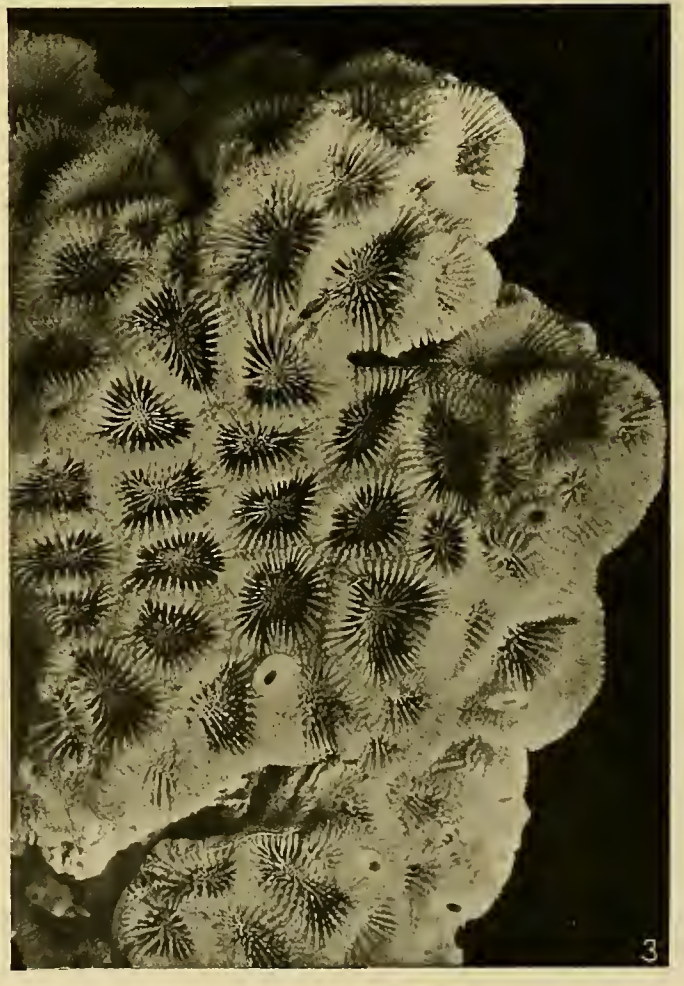
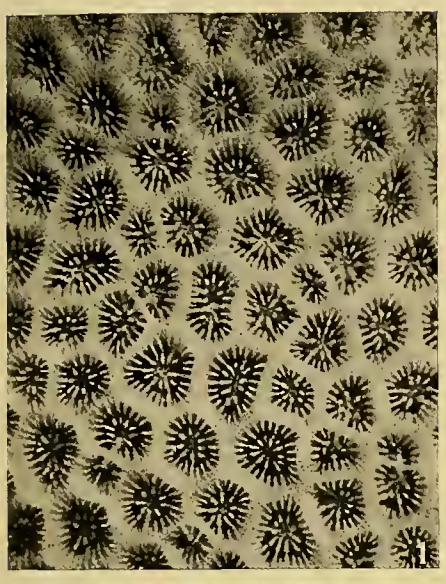
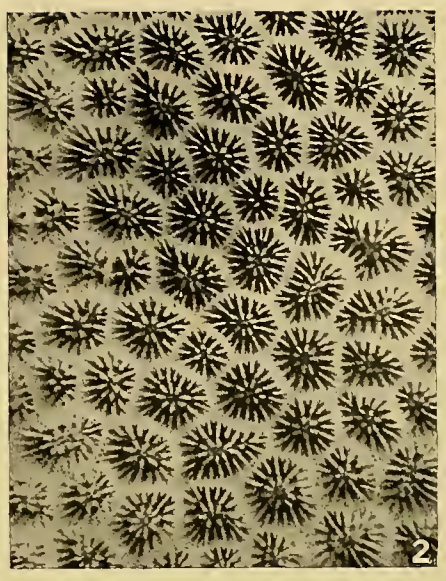


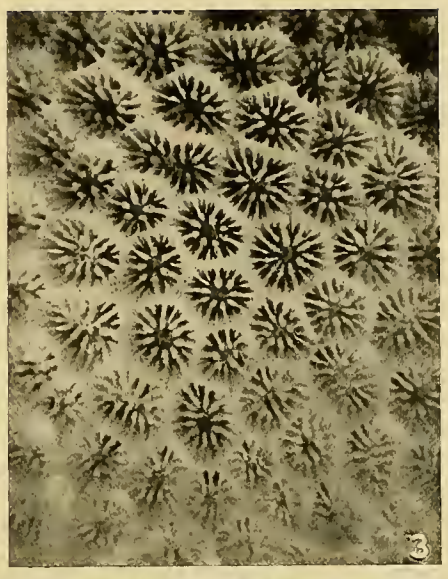


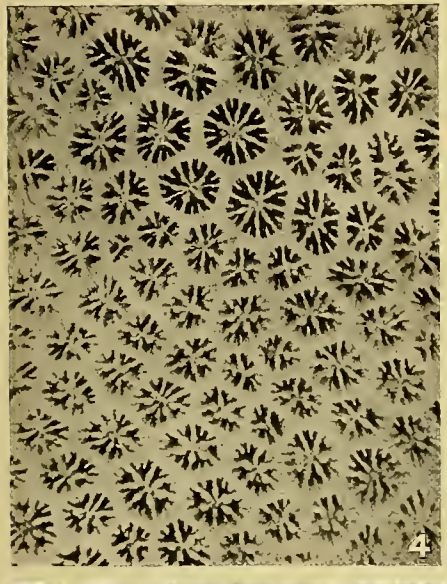


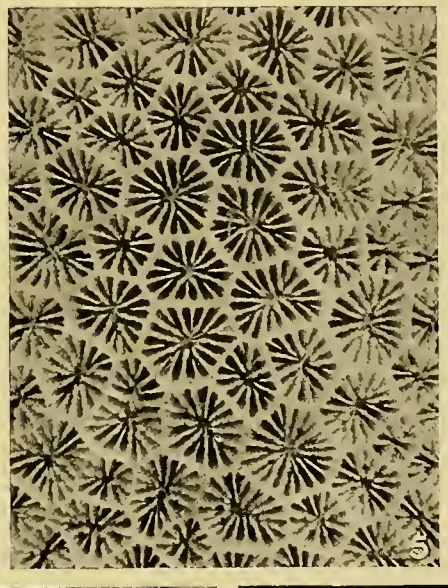
FAVIA COMPLANATA

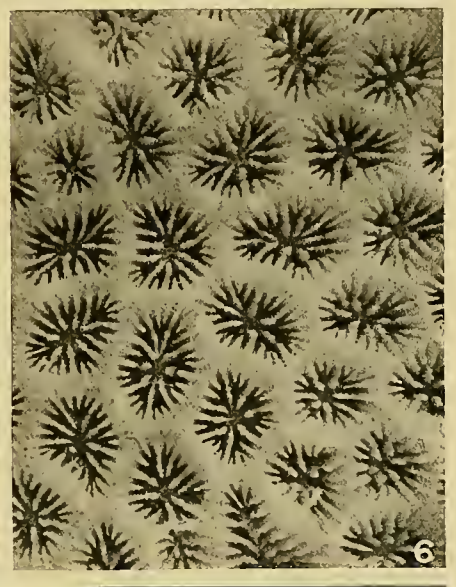


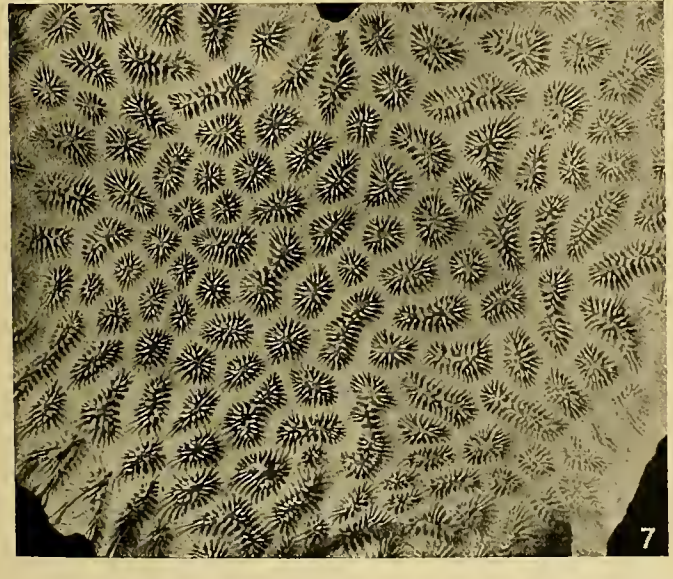


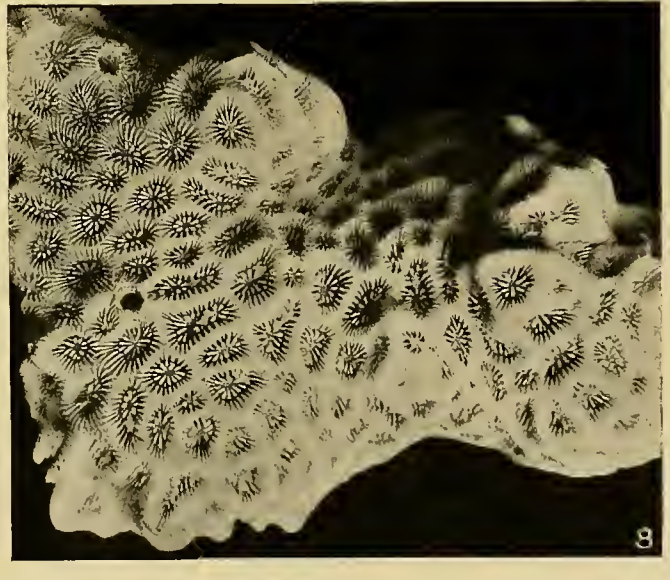




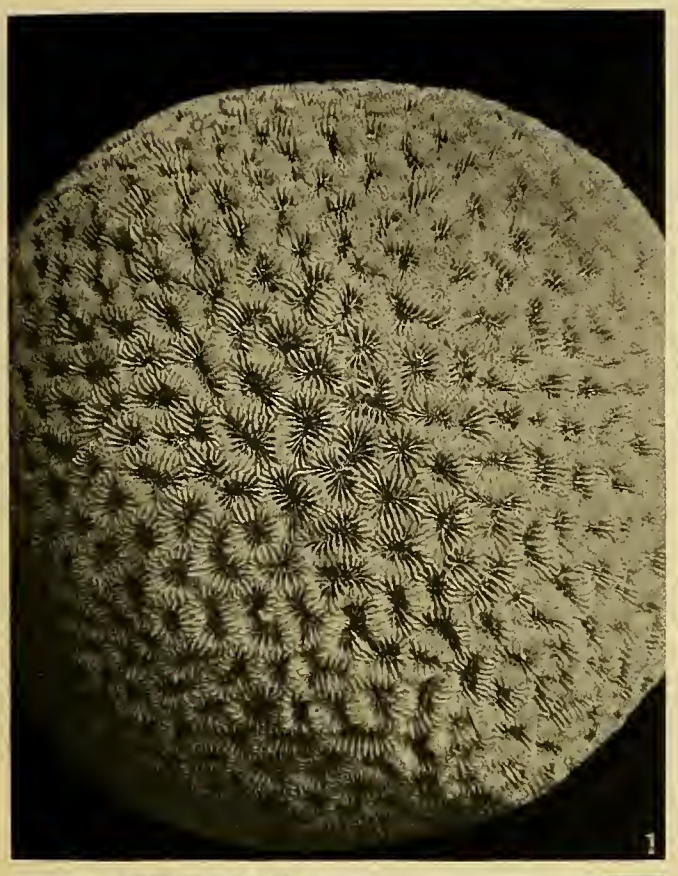


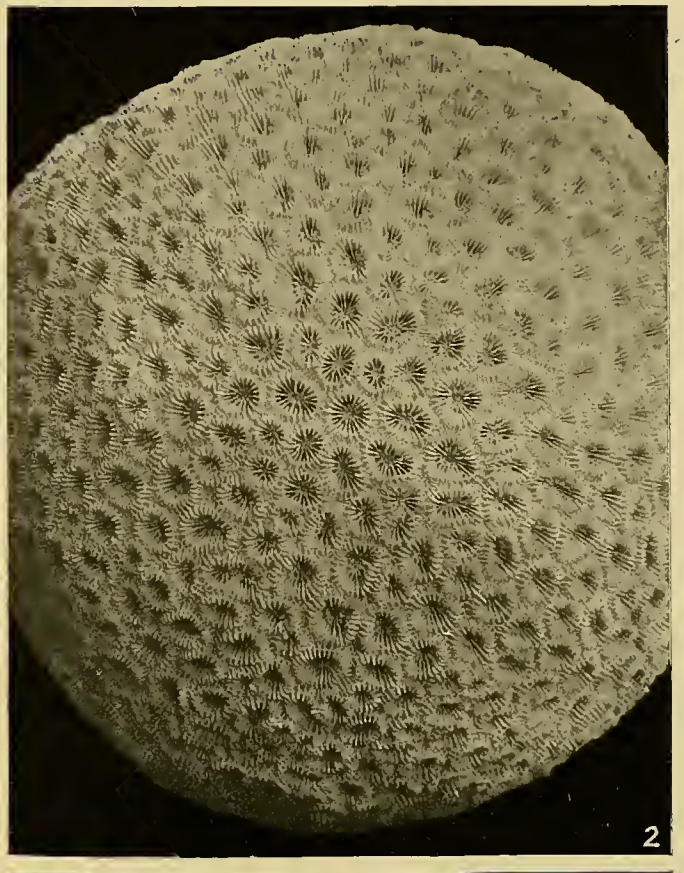


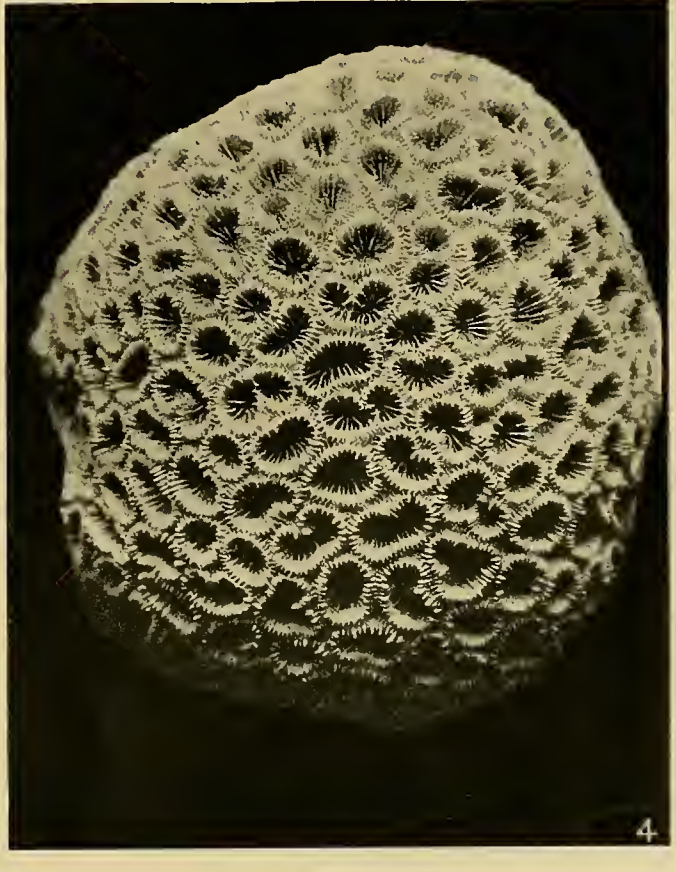




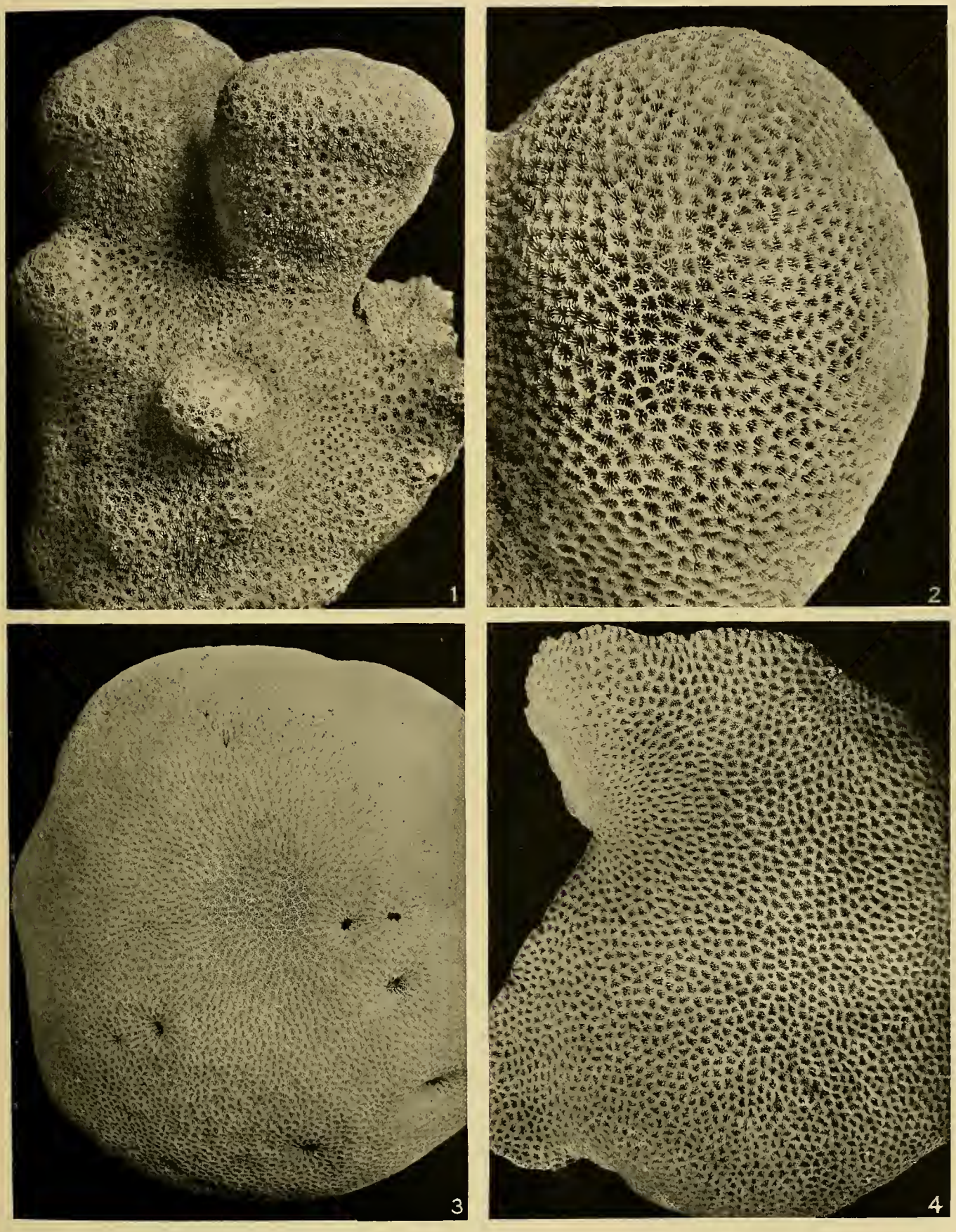
GONIASTREA



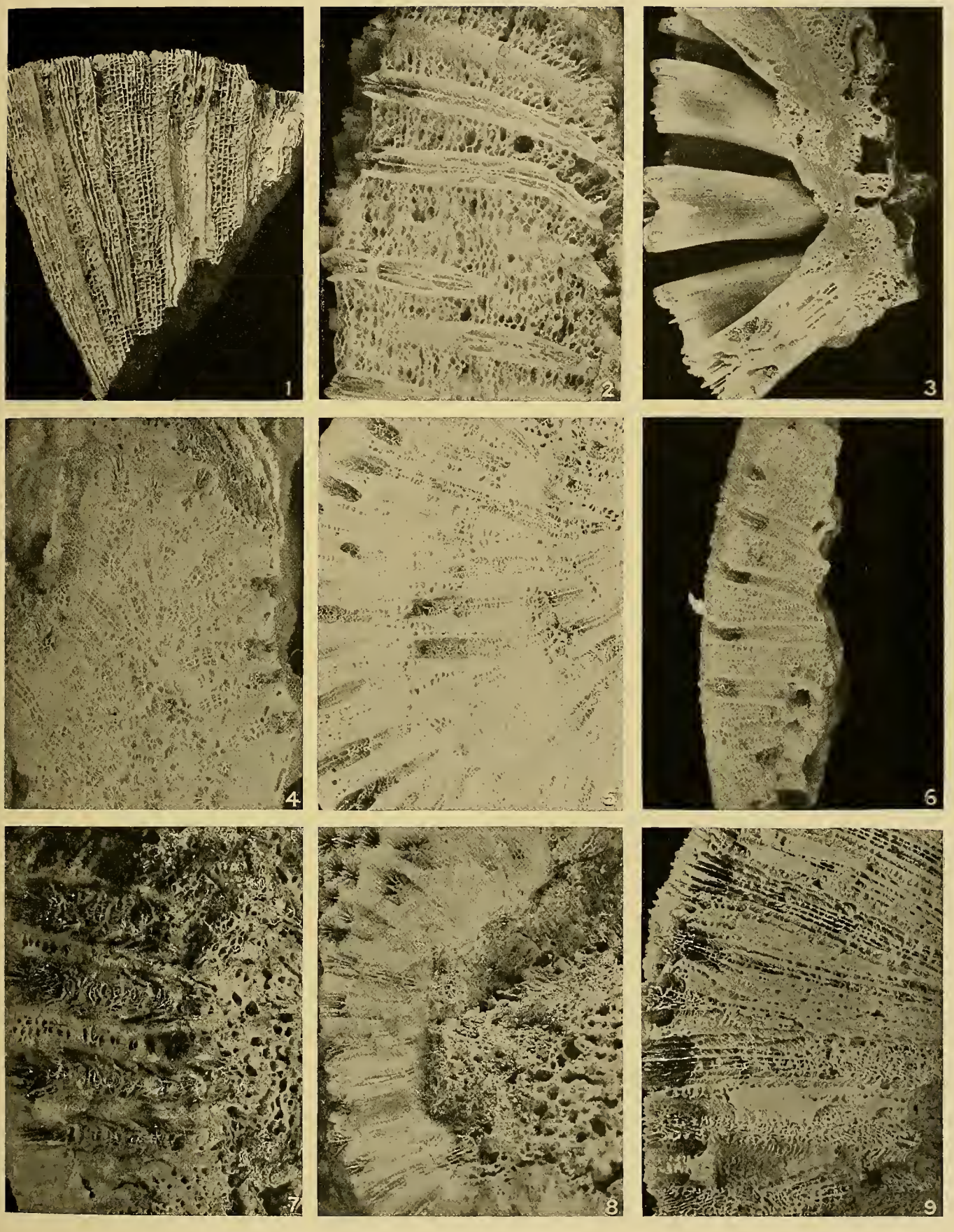




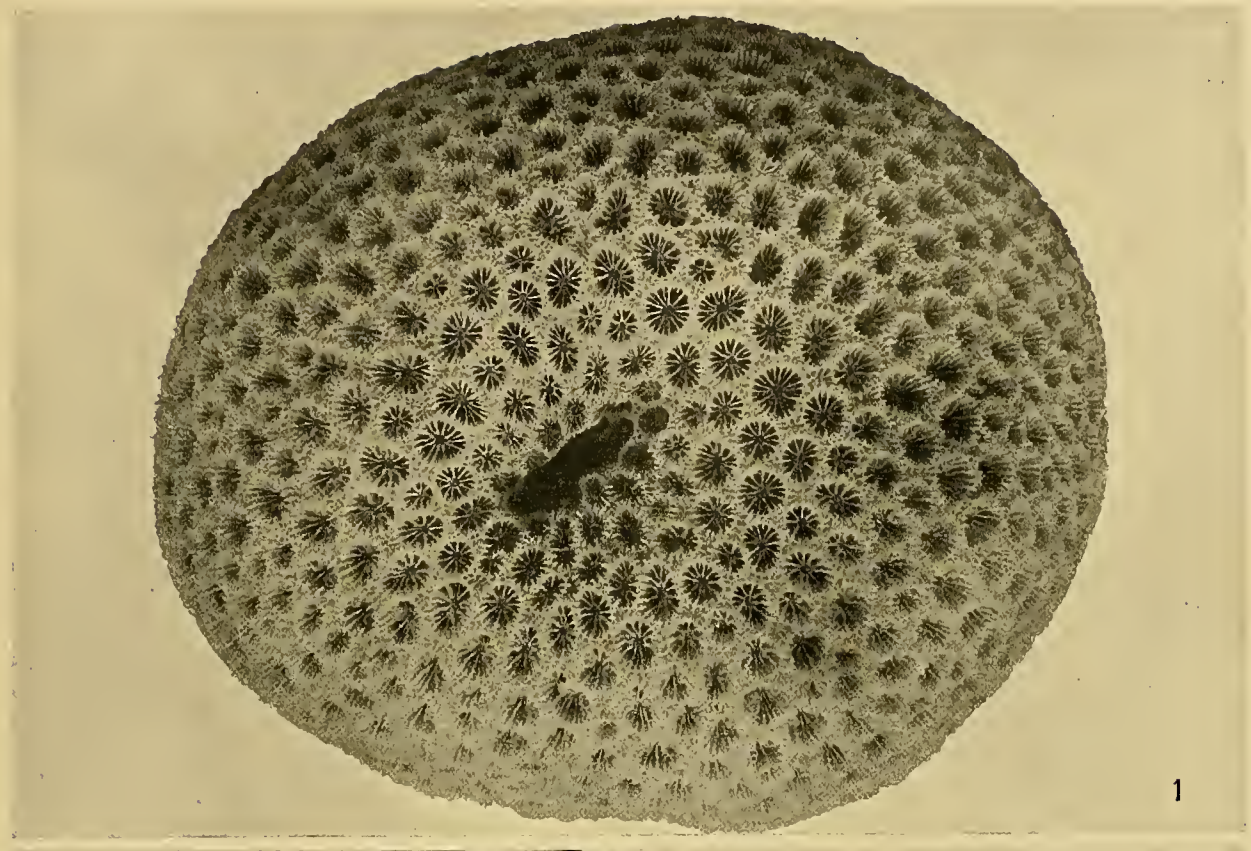
FAVIA

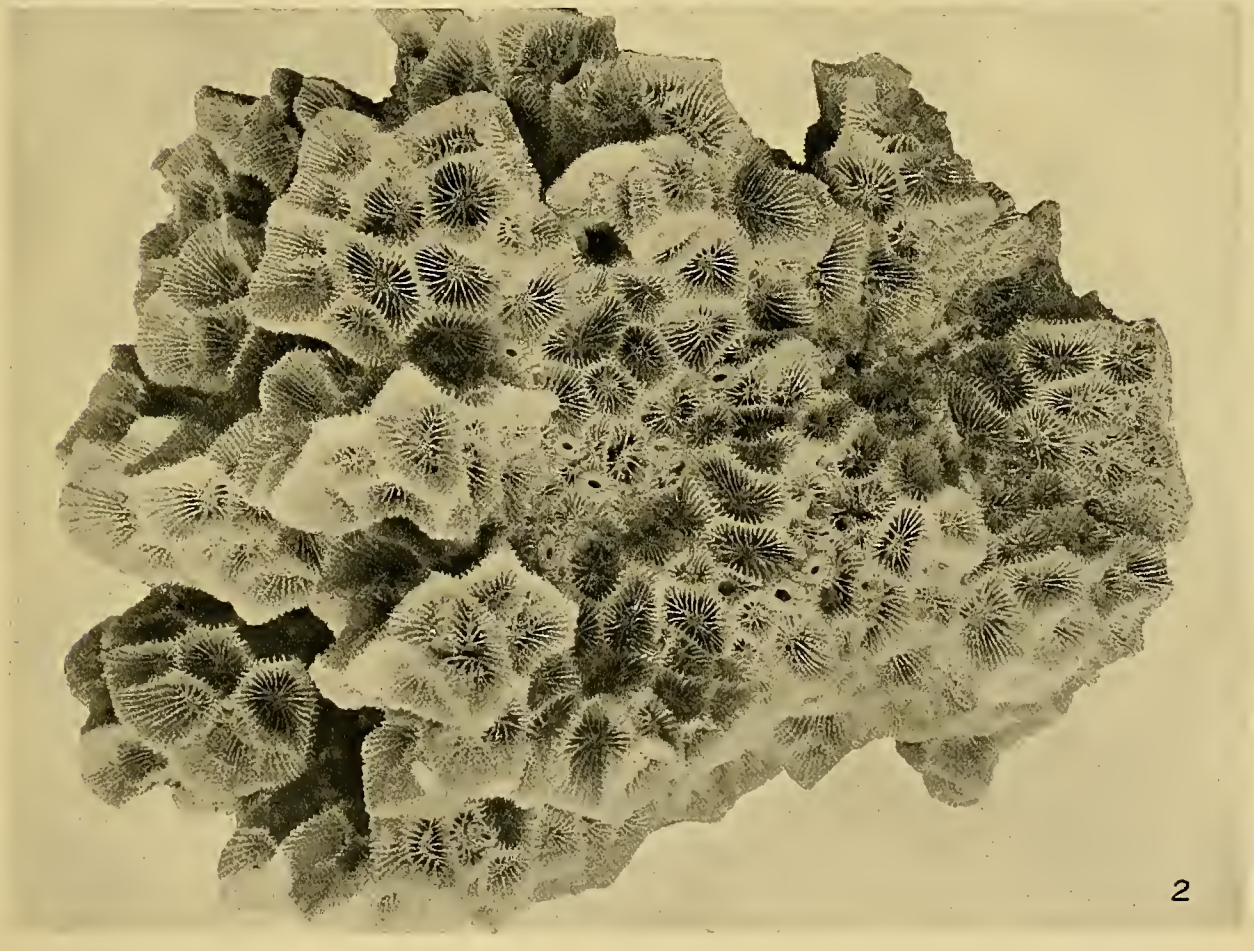


FAVIA 1, 2; GONIASTREA 3, 4



SECTIONS OF CORALLA





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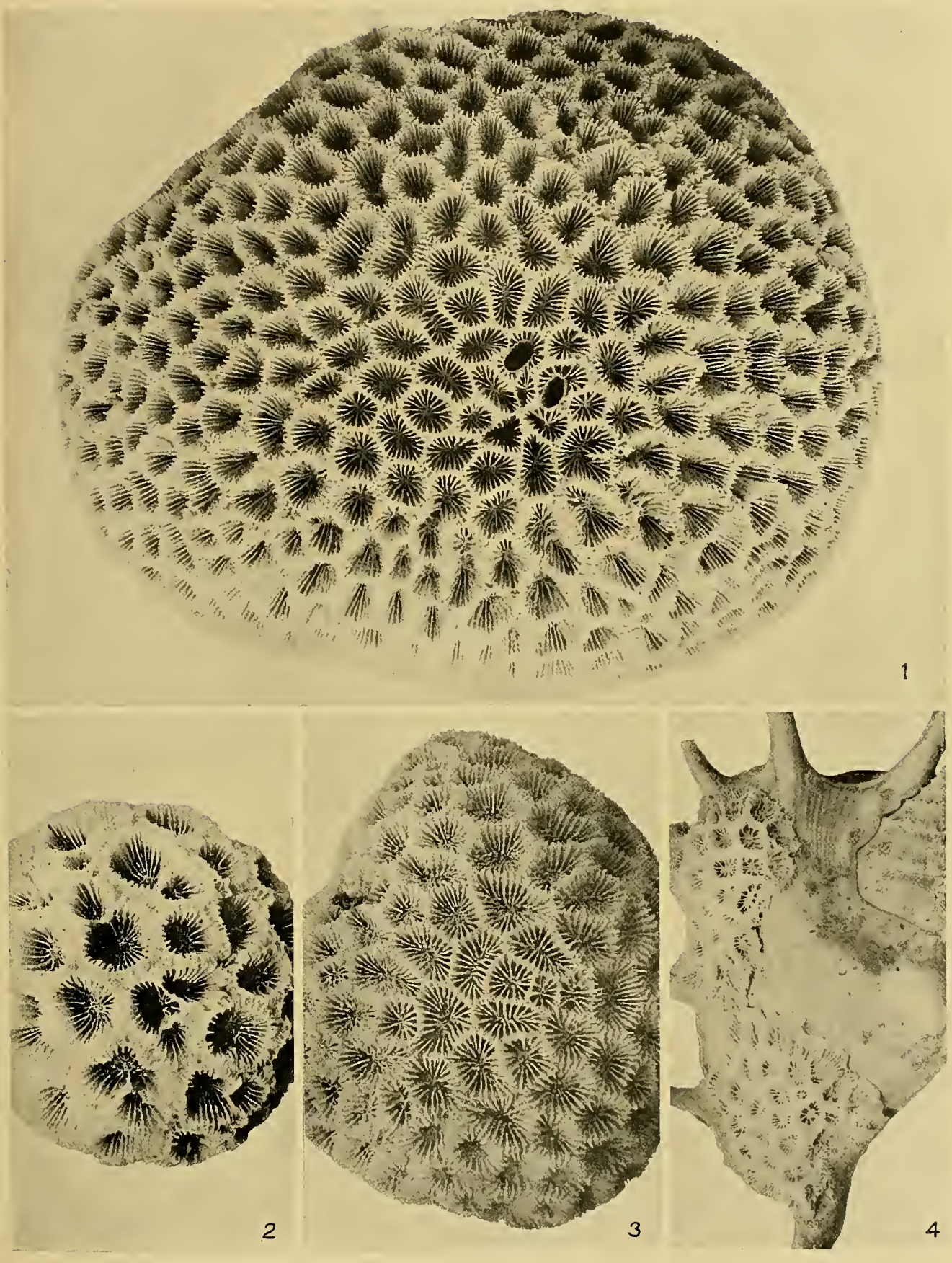

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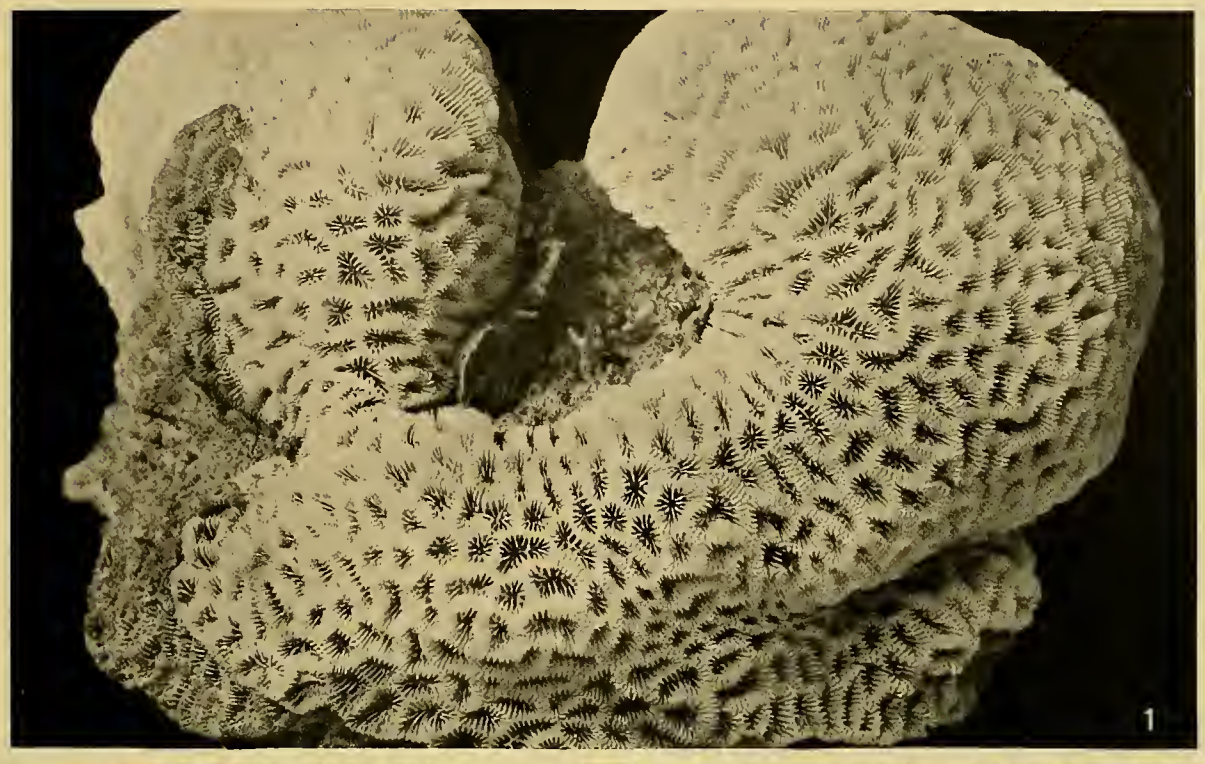
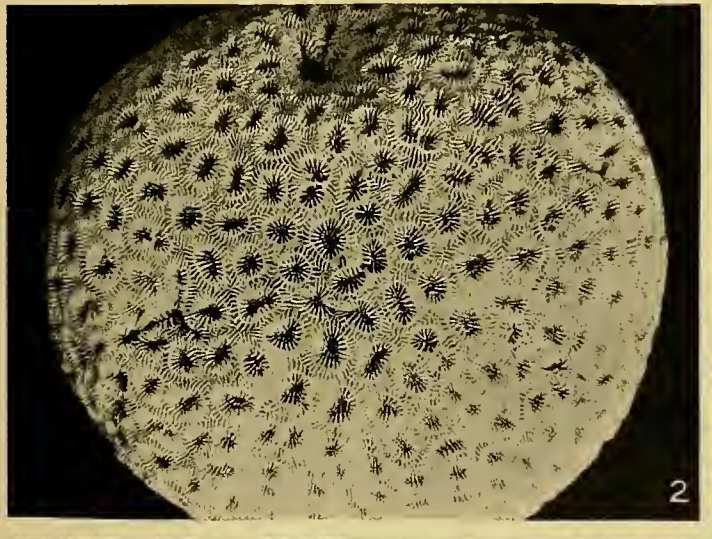
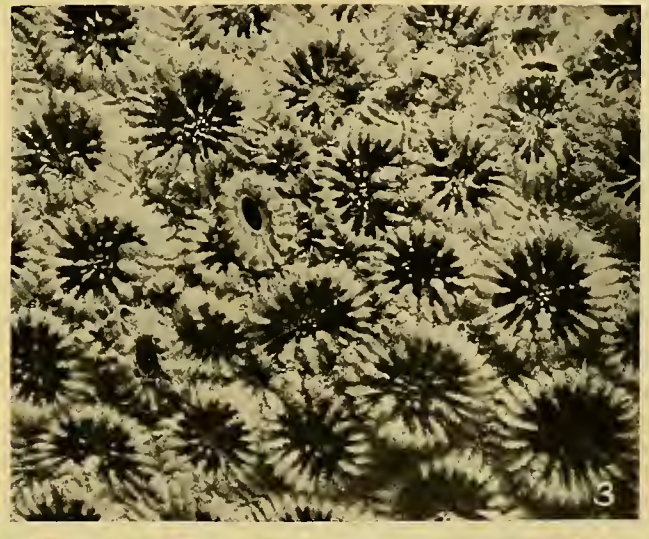
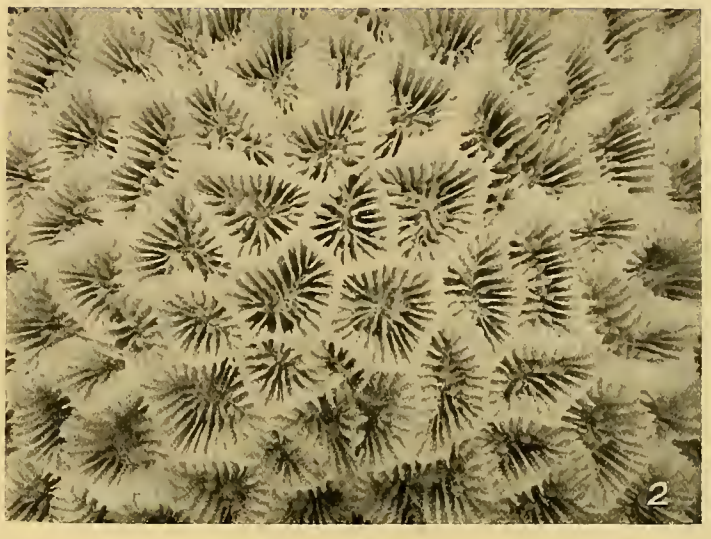
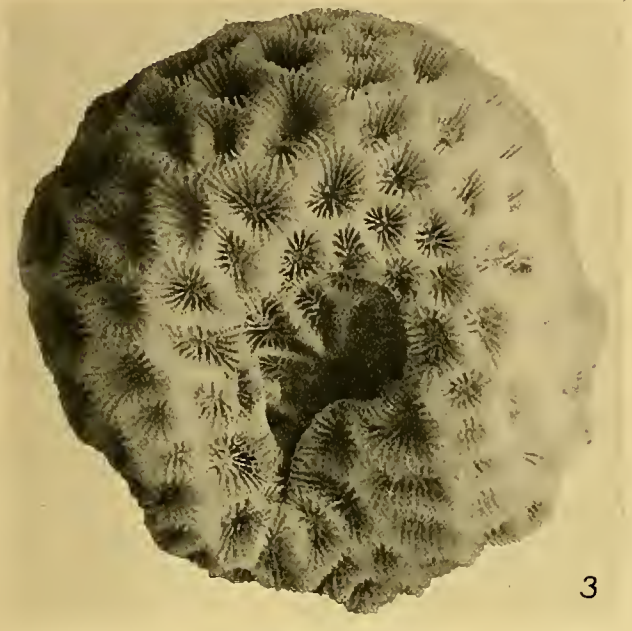


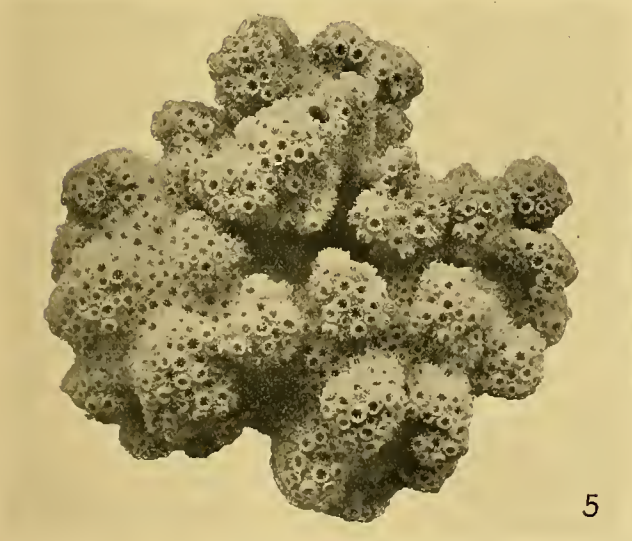


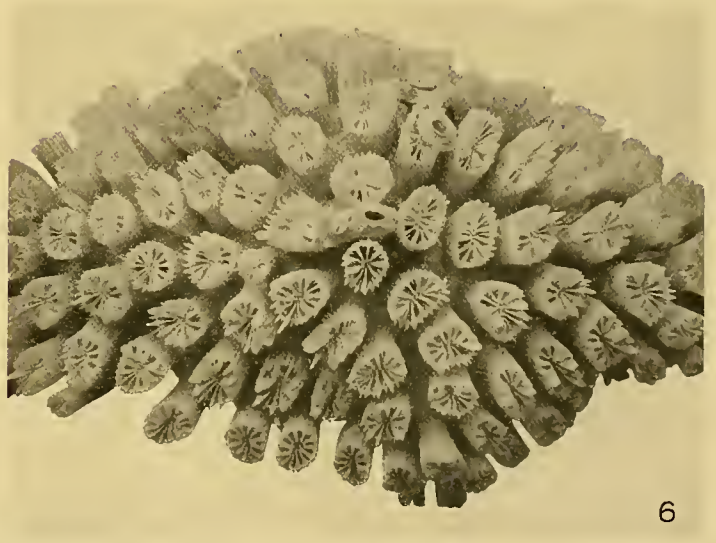


GONIASTREA 1; FAVIA 2, 3; LEPTASTREA 4; ECHINOPORA 5









CYPHASTREA 1, 5; GONIASTREA 2, 3, 4; GALAXEA 6

No. II.—COLEOPTERA: CUCUJIDÆ, CRYPTOPHAGIDÆ.

Par A. Grouvelle.

(Figures 1—6 dans le texte.)

AVEC UNE DESCRIPTION DE LA LARVE ET DE LA NYMPHE DE *PROSTOMINIA CONVEXIUSCULA* GROUVELLE [CUCUJIDÆ].

Par P. de Peyerimhoff.

(Figures A—F dans le texte.)

(Communiqué par M. le Professeur J. Stanley Gardiner, M.A., F.R.S., F.L.S.)

Lu le 18 juin 1914.

L'étude des Cucujidæ et Cryptophagidæ récoltés par la Percy Sladen Trust Expedition a donné 19 espèces reparties entre 10 genres: 9 genres et 17 espèces pour les Cucujidæ, 1 genre et 2 espèces pour les Cryptophagidæ. Sur ces 16 espèces 8 sont nouvelles, 6 Cucujidæ et 2 Cryptophagidæ; les autres appartiennent à des espèces qui, comme cela arrive si souvent pour les insectes de ces familles, ont une aire de dispersion considérable.

Si nous passons en revue les divers genres retrouvés aux Seychelles nous arrivons aux constatations suivantes.

CUCUJIDÆ.

Læmophlœus. Genre répandu dans le monde entier. Une des espèces recueillies aux Seychelles, *L. mirus* Grouvelle, appartient à la faune tropicale et subtropicale de l'Afrique; elle doit être transportée dans les fruits et autres matières végétales et, d'après des constatations faites sur des insectes de l'Amérique centrale, semble en voie de dispersion plus considérable. La deuxième, *L. propior*, est spéciale au moins jusqu'à ce jour à la faune des Seychelles; elle ne peut servir en rien pour caractériser une faune. Elle est très voisine d'espèces de l'Inde et des Indes orientales.

Oryzæphilus. Genre créé récemment et à juste titre pour l'ancien *Silvanus surinamensis* Linné, espèce cosmopolite.

Ahasuerus. L'espèce rapportée, *A. advena* Waltl, est cosmopolite.

Silvanus. Deux espèces; la 1ère, *S. scuticollis* Walker, est répandue dans toutes les régions tropicales et subtropicales de l'ancien monde; elle a été retrouvée récemment aux Antilles. La 2me, *S. hebetatus* Grouvelle, décrite de l'Afrique orientale, semble appartenir plutôt à la faune Africaine qu'à la faune Indienne.

Monanus. Ce genre est plus spéciale à l'ancien monde; une des espèces récoltées, *M. concinnulus* Walker, est devenue cosmopolite; une deuxième, *M. denticulatus*, a été décrite sur des insectes provenant des Indes orientales; la troisième, *M. ornatus*, est nouvelle, elle semble spéciale à la faune des Seychelles.

Psammœcus. Les espèces de ce genre appartiennent toutes à l'ancien continent ; elles sont plus nombreuses dans les régions tropicales et subtropicales. Sur les quatre espèces récoltées, une en mauvais état semble voisine d'une forme spéciale à Madagascar ; une deuxième, *P. simoni* Grouvelle, se rencontre depuis les Iles Philippines jusqu'à Madagascar ; les deux dernières, nouvelles, se retrouveront certainement dans les régions l'Inde et des Indes orientales ; elles semblent plus éloignées des formes spéciales à Madagascar, que des formes asiatiques.

Cryptamorpha. L'espèce trouvée, *Cryptamorpha desjardinsi* Guérin, est cosmopolite ; elle est transportée dans les régimes de bananes.

Inopeplus. Genre répandu dans les régions tropicales et subtropicales de l'ancien et du nouveau continent. L'espèce décrite, *I. mimetes*, est très probablement spéciale à la faune des Seychelles ; elle est voisine de l'*I. pictus* Cast. de Madagascar.

Prostominia. Ce genre, décrit sur un insecte du Japon, *P. lewisi* Reitter, est représenté aux Seychelles par deux espèces nouvelles : *P. scotti*, très voisine de *P. simoni* Grouvelle de Ceylan ; et *P. convexiuscula*, forme très caractérisée au milieu des autres par le développement de son épistome.

CRYPTOPHAGIDÆ.

Hapalips. Genre répandu dans les régions tropicales et subtropicales de l'ancien et du nouveau monde. Les *Hapalips* ont souvent des aires de dispersion considérables ; on ne peut à priori considérer les deux espèces nouvelles décrites comme complètement spéciales à la faune des Seychelles.

Distribution géographique des espèces.

	Groupe des Seychelles	Groupe Chagos	Groupe Amirantes	Groupe Farquhar (incl. St Pierre et Providence)	Groupe Aldabra (incl. Aldabra, Astove, Assomption et Cosmolédo)	Provenance des espèces déjà décrites
CUCUJIDÆ						
Læmophlœus mirus	—					Afrique équatoriale
Læmophlœus propior	—					
Oryzæphilus surinamensis	—					Cosmopolite
Silvanus scuticollis	—					Tend à devenir cosmopolite
Silvanus hebetatus	—					Afrique orientale
Monanus concinnulus	—					Cosmopolite
Monanus denticulatus	—					Archipel Malais
Monanus ornatus	—					
Ahasuerus advena	—					Cosmopolite
Psammœcus simoni	—					Manille, Archipel Malais, Madagascar
Psammœcus lætulus	—					
Psammœcus nitescens	—					
Psammœcus sp.	—					
Cryptamorpha desjardinsi	—					Cosmopolite
Inopeplus mimetes	—					
Prostominia scotti	—					
Prostominia convexiuscula	—					
CRYPTOPHAGIDÆ						
Hapalips scotti	—					
Hapalips championi	—					

Cucujidæ. Uleiotini.

LÆMOPHLŒUS Cast., Hist. Nat. Ins. Col., ii, 1840, p. 385.

1. *Læmophlœus* (*Silvanophlœus**) *mirus*, Grouvelle.

Læmophlœus mirus Grouvelle, Bull. Soc. Ent. France, 1905, p. 142.

Le *L. mirus*, décrit sur des insectes provenant de Madagascar, a été retrouvé sur la côte occidentale de l'Afrique, et récemment nous avons eu l'occasion d'examiner des exemplaires venant de l'Amérique centrale. Le *L. mirus* doit être transporté dans les matières végétales; il tend à devenir cosmopolite.

2 exemplaires.

Loc. "Seychelles. Mahé: Cascade Estate, ca. 800 feet, 1908—9."

2. *Læmophlœus propior*, n. sp.

Elongatus, subparallelus, depressus, nitidus, glaber; capite prothoraceque rufo-piceis, antennis pedibusque dilutioribus, elytris piceis, singulo plaga maxima, testacea, vix perspicue piceo-infuscata, notato. Antennæ apud marem elongatissimæ, haud clavatæ, apud feminam submoniliformes; clava triarticulata; 2° et 3° articulis subæqualibus. Caput transversum, depressum, tenuissime parceque punctulatum, antice sinuatum, ante antennarum bases arcuatim et fronte in longitudinem striatum; labro sat magno. Prothorax subquadratus, utrinque in longitudinem striatus, parcissime tenuissimeque punctulatus; angulis anticis acutis, prominulis, posticis obtusis, haud hebetatis, basi utrinque ad extremitatem sinuata. Scutellum subtriangulare, læve. Elytra elongato-ovata, apice subtruncata, ultimum segmentum abdominis haud obtegentia; in singulo elytro stria suturali impressa, fere integra, et lineis punctulatis, vix perspicuis, juxta marginem apicalem magis indicatis. Long. 1·2—1·5 mill.

Allongé, presque parallèle, déprimé, brillant, glabre; antennes et pattes roux testacé clair, tête et prothorax plus assombris, élytres brun de poix, marqués chacun d'une grande tache testacée, très légèrement teintée de nuance de poix; dessous du corps brun de poix peu foncé, rougeâtre dans la partie antérieure. Antennes atteignent chez le mâle presque la longueur du corps, sans massue, plus courtes chez la femelle, submoniliformes, terminées par une massue de trois articles lâche, allongée, peu accentuée; 2me et 3me article subégaux. Tête triangulaire, environ deux fois plus large que longue, déprimée sur le front, sinuée au bord antérieur, éparsement et très finement pointillée; strie interantennaire arquée, bien marquée, séparant le front de l'épistome, ce dernier se développant dans un plan un peu inférieur à celui du front; strie longitudinale du front marquée; labre très nettement visible. Prothorax subcarré, à peine rétréci à la base, à peine plus large en avant que la tête chez le mâle, un peu plus étroit chez la femelle, strié de chaque côté, très éparsement et très finement pointillé; angles antérieurs aigus, saillants, postérieurs obtus, non émoussés; base subtronquée au milieu, sinuée de chaque côté vers les extrémités, très finement rebordée entre les stries longitudinales du disque. Ecusson subtriangulaire,

* *Silvanophlœus* Sharp, Biol. Centr.-Am., Col. II. 1, 1899, p. 537: treated as a subgenus of *Læmophlœus*.—H. SCOTT.

environ deux fois plus large à la base que long, lisse. Elytres en ovale allongé, subtronqués au sommet, un peu plus larges à la base que la base du prothorax, subanguleux aux épaules, un peu plus de deux fois plus longs que larges ensemble, laissant en partie à découvert le dernier segment de l'abdomen, pliés sur les côtés; stries suturales bien marquées, effacées vers la base de l'élytre; lignes ponctuées du disque presqu'effacées sur le disque, serrées, bien visibles contre la marge apicale formée au sommet par la jonction de l'intervalle suturale et de la marge latérale. Cavités des hanches antérieures fermées; hanches antérieures, intermédiaires et postérieures écartées. Bord antérieur du dessous de la tête tronqué, bordé par une strie arquée.

Voisin du *L. proximus* Grouvelle de la région indienne: distinct par sa coloration en partie brun de poix, et par la striation de l'extrémité des élytres marquée et serrée qui fait contraste à côté de la striation du disque.

Environ 35 exemplaires.

Loc. "Seychelles. Silhouette: near Mont Pot-à-eau, ca. 1500 feet, VIII. 1908; forest just above the Mare aux Cochons plateau, over 1000 feet, IX. 1908. Mahé: Mare aux Cochons district, ca. 1500 feet, I.—II. 1909.

In Silhouette most, if not all, the specimens were found in felled heads of an endemic palm, *Verschaffeltia splendida*. They were found among the still unopened central (i.e. youngest) leaves. I specially noted at the time that they were not present in growing trees, but only in decaying heads of felled trees, in which however the leaves were still green. Specimens of certain other species described in this paper were also found in these felled palm-heads: *Monanus ornatus*, *Psammœcus* of perhaps more than one species, and *Hapalips scotti*.—H. Scott."

Silvanini.

Oryzæphilus Ganglbauer, 1899, Käf. Mitteleur., iii, p. 584.

3. *Oryzæphilus surinamensis* (Linné).

Dermestes surinamensis Linné, 1758, Syst. Nat., ed. X, p. 375.

Silvanus surinamensis Latreille, 1807, Gen. Crust. Ins., iii, p. 20.

Oryzæphilus surinamensis Ganglbauer, 1899, Käf. Mitteleur., iii, p. 584; Reitter, 1911, Faun. Germ., iii, p. 46; Grouvelle, 1912, Ann. Soc. Ent. France, lxxxi, p. 318.

Dermestes sexdentatus Fabricius, 1792, Ent. Syst., i, p. 232.

Colydium frumentarium Fabricius, 1792, Ent. Syst., i, pars 2, p. 496.

Silvanus bicornis Erichson, 1848, Naturg. Ins. Deutschl., iii, p. 337.

Silvanus mercator Fauvel, 1889, Rev. d'Ent. Caen, viii, p. 132.

Espèce cosmopolite. 3 exemplaires.

Loc. "Seychelles. Silhouette: from near Mont Pot-à-eau, and from Mare aux Cochons, VIII.—IX. 1908. Mahé: Port Victoria."

AHASUERUS Gozis, 1881, Ann. Soc. Ent. France, 6. sér., i., Bull., p. cxxvii.

4. *Ahasuerus advena* (Waltl).

Cryptophagus advena Waltl, 1832, Faunus, p. 169.

Silvanus advena Erichson, 1848, Naturg. Ins. Deutschl., iii, p. 339; Casey, 1884, Trans. Amer. Ent. Soc., xi, p. 73, pl. 4, fig. 6.

Cathartus advena Reitter, 1876, in Harold, Col. Hefte, xv, p. 127; Ganglbauer, 1899, Käf. Mitteleur., iii, pp. 587 et 588.

Ahasuerus advena Gozis, 1881, Ann. Soc. Ent. France, 6. sér., i., Bull., p. cxxvii.

Cryptophagus guerini Allibert, 1847, Rev. Zool., p. 12.

Latridius musæorum Ziegler, 1845, Proc. Acad. Philad., ii, p. 270.

Cryptophagus striatus Rouget, 1876, Ann. Soc. Ent. France, 5. sér., vi., Bull., p. ccvii.

Espèce cosmopolite. 3 exemplaires.

Loc. "Seychelles. Mahé: Cascade Estate, ca. 800 feet, 1908—9."

SILVANUS Latreille, 1807, Gen. Crust. Ins., iii, p. 19.

5. *Silvanus scuticollis*, Walker.

Silvanus scuticollis Walker, 1859, Ann. Mag. Nat. Hist., 3. ser., iii, p. 53; Grouvelle, 1908, Ann. Soc. Ent. France, lxxvii, p. 491.

Silvanus triangulus Reitter, 1876, in Harold, Col. Hefte, xv, p. 60.

Cette espèce tend à devenir cosmopolite; décrite de Ceylan elle a été retrouvée dans tout l'Archipel Malais, au Japon, sur la côte d'Afrique, et récemment à la Guadeloupe.

7 exemplaires.

Loc. "Seychelles. Silhouette: near Mont Pot-à-eau, ca. 1500 feet, VIII. 1908; Mare aux Cochons and forest above, over 1000 feet, IX. 1908."

6. *Silvanus hebetatus*, Grouvelle.

Silvanus hebetatus Grouvelle, 1912, Ann. Soc. Ent. France, lxxxi, p. 339.

Le type de l'espèce provient de l'Afrique occidentale.

1 exemplaire.

Loc. Seychelles. Silhouette: Mare aux Cochons, IX. 1908.

MONANUS Sharp, Trans. Ent. Soc. London, 1879, pp. 85, 86; Fauvel, 1903, Rev. d'Ent. Caen, xxii, p. 379.

Emporius Ganglbauer, 1899, Käf. Mitteleur., iii, p. 578 et 586.

Subgen. MONANUS, s. str.

7. *Monanus denticulatus*, Grouvelle.

Monanus denticulatus Grouvelle, 1912, Ann. Soc. Ent. France, lxxxi, p. 364.

Le type de l'espèce provient de l'Archipel Malais.

1 exemplaire.

Loc. "Seychelles. From Long Island, a small cultivated islet off the coast of Mahé, VII. 1908, 1 specimen."

8. *Monanus concinnulus* (Walker).

Monotoma concinnula Walker, 1858, Ann. Mag. Nat. Hist., 3 ser., ii, p. 207; (Grouvelle) 1908, Ann. Soc. Ent. France, lxxvii, p. 489.

Silvanus signatus Frauenfeld, 1867, Verh. zool.-bot. Ges. Wien, xvii, p. 438, pl. 12, f. 28.

Cryptamorpha fasciata Wollaston, 1874, Ent. Month. Mag., x, p. 169.

Cathartus fascipennis Reitter, 1876, in Harold, Col. Hefte, xv, p. 129.

Espèce cosmopolite. 10 exemplaires.

Loc. "Seychelles. Silhouette: forest immediately above Mare aux Cochons, over 1000 feet, IX. 1908. Mahé: Cascade Estate and forest above, ca. 800 feet and over; Mare aux Cochons district, ca. 1500 feet, I.—II. 1909."

Subgen. Monanops Grouvelle, 1912, Ann. Soc. Ent. France, lxxxi, p. 344.

9. *Monanus* (*Monanops*) *ornatus*, n. sp. (Fig. 1, elytra).

Elongatus, parallelus, modice convexus, nitidus, flavo-pubescens, piceus; antennarum basi, bucca pedibusque pisceo-testaceis, his ultimis paulo obscurioribus, elytris duabus maculis transversis ochraceis sectis: 1ª macula a basi quam 2ª latiore, 2ª juxta suturam stricte interrupta. Antennæ breves; 3° articulo parum elongato. Caput transversum, convexiusculum, subparce punctulatum; oculis magnis, temporibus minutis, haud dentatis. Prothorax basi modice angustatus, paulo longior quam in maxima latitudine latior; margine antico arcuato, medio stricte pulvinato; angulis anticis acutis exterius prominulis; lateribus bisinuatis, tenuissime crenulatis; angulis posticis acutissimis, basi arcuata, marginata; disco dense punctulato. Scutellum transversissimum, apice late obtusum. Elytra apice conjunctim rotundata, circiter ter longiora quam simul latiora, dense lineato-punctata; intervallis 2°, 4°, et 6° (suturali non numerato) quam aliis paulo latioribus. Spatium axillare coxarum posticarum obtuse angulosum. Long. 3—3·5 mill.

Parallèle, environ cinq fois plus long que large, modérément convexe, brillant, couvert d'une pubescence flave, fine, médiocrement allongée, oblique, assez dense, ne masquant pas le tégument, brun de poix avec les antennes sauf les derniers articles, et la bouche testacées, teintées de nuance de poix, pattes un peu moins claires; élytres coupés transversalement par deux bandes ochracées; la 1ère près de la base très large, entière, la 2me au delà du milieu plus étroite, interrompue très près de la suture et n'atteignant pas les bords latéraux. Antennes plutôt courtes, un peu plus allongées chez le mâle que chez la femelle; 1er article cylindrique, plus long que large, 2me et 3me subégaux, un peu plus longs que large, 4me et 6me subsphériques, presque plus étroits que les articles voisins, 5me un plus long que large, 7me subcarré, 8me transversal, plus étroit que 7me, 9me à 11me formant une massue environ trois fois plus longue que large, dont les deux premiers articles subégaux sont trans-

Fig. 1. *Monanus ornatus*, n. sp. elytra, × 16.

versaux et dont le dernier environ aussi long que large est émoussé à l'extrémité; l'ensemble des articles 7 à 11 forme presqu'une massue progressive. Tête triangulaire, plus large que longue, un peu convexe, densement pointillée sur le front, saillante en forme de trapèze lisse en avant des naissances des antennes; yeux gros, échancrant à peine les marges latérales du front; tempes très petites. Prothorax médiocrement convexe, un peu rétréci à la base, assez fortement bisinué sur les côtés, un peu plus long que large dans sa plus grande largeur, au niveau des angles antérieurs; bord antérieur arqué en avant, légèrement rebordé en bourrelet au milieu; angles antérieurs aigus, saillants latéralement; côtés très finement denticulés surtout en avant; angles postérieurs en forme de petite saillie aigue; base arquée, rebordée; ponctuation fine, serrée, intervalles à peine visiblement alutacés. Ecusson très transversal, en angle largement obtus au sommet. Elytres subtronqués à la base, arrondis aux épaules, arrondis ensemble au sommet, environ trois fois plus longs que larges ensemble dans leur plus grande largeur, densement ponctués en lignes; intervalles alternes, à partir du 3me en comptant l'intervalle sutural, un peu plus large que les autres; marges latérales pliées; lignes ponctuées atténuées au sommet; stries suturales bien marquées sur la moitié apicale de la longueur. 1er segment de l'abdomen plus court que le métasternum. Espace axillaire des hanches postérieures s'avançant en angle obtus, largement émoussé sur le premier segment de l'abdomen.

14 exemplaires.

Loc. "Seychelles. Silhouette: from near Mont Pot-à-eau, ca. 1500 feet, VIII. 1908; forest above Mare aux Cochons, over 1000 feet, one specimen being recorded as found among the leaves of a felled endemic palm, *Verschaffeltia splendida* (see under *Læmophlœus propior*, p. 144)."

Psammœcini.

Psammœcus Latreille, 1829, Règne Anim., 2e éd. v, p. 135.

10. *Psammœcus simoni*, Grouvelle.

Psammœcus simoni Grouvelle, 1892, Ann. Soc. Ent. France, lxi, p. 287; Col. Rég. Indienne, in Ann. Soc. Ent. France, lxxvii, 1908, p. 476.

Cette espèce a été décrite sur des exemplaires provenant des Iles Philippines; elle a été retrouvée depuis dans les Iles Malaises, la région indienne et à Madagascar.

18 exemplaires.

Loc. "Seychelles. Silhouette: Mare aux Cochons and forest above, over 1000 feet, IX. 1908. Mahé: from country above Port Glaud and near Morne Blanc, a rather dry scrubby area with a mixture of imported and endemic vegetation, 500—1000 feet, XI. 1908."

11. *Psammœcus* sp.

Un exemplaire a coloration incomplète.

Loc. Seychelles. Silhouette, VIII. 1908.

12. *Psammœcus lætulus*, n. sp. (Fig. 2, elytra).

Oblongus, vix 2 et ½ longior quam latior, sat convexus, nitidulus, flavo-pubescens; antennarum articulis 6—10 nigris; capite prothoraceque rufo-testaceis; elytris nigris, singulo ochraceo-testaceo bimaculato: 1ª macula subbasilari, fere usque longitudinis medium extensa, latus subattingente, postice cum alterius elytri macula juncta; 2ª oblonga, apicali, elongata, suturam fere attingente et usque latus extensa. Caput transversissimum. Prothorax basin versus valde angustatus, magis duplo latior quam longior, subdense punctatus, lateribus denticulis ex parte longioribus quam latioribus armatis. Elytra suboblonga, apice conjunctim rotundata, circiter sesquilongiora quam simul in maxima latitudine latiora, striato-punctata; intervallis, extra apicem, quam punctis latioribus. Long. 2·7 mill.

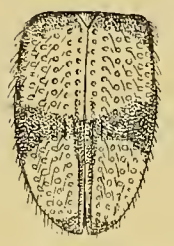


Fig. 2. *Psammœcus lætulus*, n. sp., elytra, × 16.

Oblong, un peu moins de deux fois et demie plus long que large dans sa plus grande largeur, convexe, légèrement déprimé sur le disque des élytres, brillant, couvert d'une pubescence flave, fine, assez dense et assez longue ne masquant pas la couleur du tégument. Antennes testacées; articles 6 à 10 noirs; tête et prothorax roux testacés; élytres jaunes-testacés étroitement bordés de noir à la base, coupés transversalement vers le milieu de la longueur, par une bande noire s'avançant sur la suture, du côté de l'écusson, en angle très aigu et du côté du sommet en marge étroite*; bande transversale atteignant le bord latéral en s'élargissant progressivement, se réflechissant ensuite contre ce bord pour le border étroitement jusqu'à l'épaule. Antennes allongées, s'épaississant faiblement et progressivement vers l'extrémité; 3me article environ une fois et demie plus long que large, 7me à 10me subcarrés. Tête plus de deux fois et demie plus large que longue, faiblement convexe, couverte d'une ponctuation presque serrée, s'effaçant vers l'épistome, front relevé, striolé de chaque côté entre l'œil et la base de l'antenne, strié entre ces bases; épistome infléchi, environ deux fois plus large que long; labre petit; yeux saillants presqu'en forme de demi-cercle, à petites facettes. Prothorax à peine plus large que la tête dans sa plus grande largeur, fortement rétréci à la base, brièvement arrondi aux angles antérieurs, d'abord subparallèle, puis convergent vers la base, presque deux fois plus large que long, en angle obtus aux angles postérieurs, couvert d'une ponctuation semblable à celle de la tête; côtés armés chacun de six denticules étroits irrégulièrement espacés, les 2me, 3me et 4me à partir de la base un peu inégaux, un peu plus longs que larges; base tronquée, étroitement rebordée. Ecusson moins de quatre fois moins large que la base du prothorax. Elytres arqués à la base, brièvement arrondis aux épaules, alors environ deux fois plus larges que le prothorax à la base, ovales, faiblement élargis jusque dans les environs du milieu de la longueur, arrondis ensemble au sommet, environ une fois et demie plus longs que larges ensemble dans leur plus grande largeur, ponctués-striés; stries atténuées vers le sommet; intervalles des stries ponctuées plus larges que les points; stries suturales marquées jusqu'au sommet; marges latérales très étroitement rebordées. Sillon latéral des hanches antérieures très

* The angular production forwards along the suture of the transverse black band is unfortunately not shown in the figure.—H. Scott.

accentué, sa marge antérieure lisse. Métasternum longitudinalement sillonné, ponctué sur la région extérieure de la base. Premier segment de l'abdomen subégal au métasternum; sa saillie entre les hanches postérieures aigue. Hanches intermédiaires contigues.

Voisin de *P. reitteri* Grouvelle, mais très nettement plus large.

4 exemplaires.

Loc. "Seychelles. Silhouette: Mare aux Cochons, IX. 1908. Mahé: Cascade Estate, ca. 1000 feet, I. 1909."

13. *Psammœcus nitescens*, n. sp. (Fig. 3, elytra).

Ovatus, 2 et ½ longior quam latior, convexus, nitidus, flavo-pubescens; antennarum articulis 6—10 nigris; capite prothoraceque fusco-rufis vel nigris; elytris ochraceis transversim nigro-maculatis, sutura strictissime, margine laterali deflexa, apiceque infuscatis; elytrorum fascia nigra transversa postice latissime angulosa antice in suturam anguloso-producta. Caput transversissimum. Prothorax basin versus valde angustatus, circiter in maxima latitudine duplo latior quam longior, crebre punctatus, lateribus denticulis ex parte longioribus quam latioribus armatis. Elytra suboblonga, apice conjunctim rotundata, fere duplo longiora quam simul in maxima latitudine latiora, striato-punctata; intervallis quam punctis latioribus. Long. 2·5—2·7 mill.

Ovale, environ deux fois et demie plus long que large dans sa plus grande largeur, convexe, à peine déprimé sur le disque des élytres, très brillant sur les élytres, un peu moins sur la tête et le prothorax, couvert d'une pubescence flave, fine, assez longue, ne masquant pas la couleur du tégument. Antennes testacées, articles 6—10 noirs; tête et prothorax roux enfumé plus ou moins foncé, parfois noirs; élytres jaunes-testacés, coupés transversalement, un peu après le milieu, par une bande noire, médiocrement large, atteignant les bords latéraux, s'élargissant de chaque côté de la suture de l'intérieur à l'extérieur, formant à son bord postérieur un angle très obtus et se soudant à la tache apicale, saillante en angle aigue sur la suture à son bord antérieur*, marges latérales obscurcies entre les épaules et la bande transversale, très étroitement rembrunies entre cette bande et le sommet, celui-ci assez largement rembruni. Antennes allongées, s'épaississant faiblement et progressivement vers l'extrémité; 3me article un peu moins d'une fois et demie plus long que large, 8me à 10me subcarrés. Tête environ deux fois plus large que longue, modérément convexe, couverte d'une ponctuation très serrée, s'effaçant sur l'épistome, celui-ci fortement infléchi, séparé du front par un pli arqué, brièvement relevé de chaque côté entre l'œil et la base de l'antenne; épistome testacé, subrectangulaire, environ deux fois plus large que long; labre très-petit; yeux saillants presqu'en forme de demi-cercle, à petites facettes. Prothorax faiblement rétréci en avant, fortement à la base, à peu près aussi large dans sa plus grande largeur que la tête au niveau des yeux, moins de deux fois plus large dans sa plus grande largeur que long, couvert d'une ponctuation très serrée; bord antérieur arqué en avant dans le milieu, sinué de chaque côté; angles antérieurs obtus; côtés arrondis, armés de six denticules

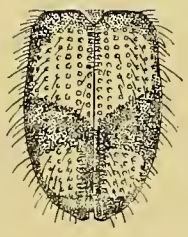


Fig. 3. *Psammœcus nitescens*, n. sp., elytra, × 16.

* Cf. footnote on preceding page.—H. Scott.

triangulaires dont le 3me est un peu plus long que large à la base; base tronquée, rebordée en bourrelet au milieu. Ecusson environ trois fois moins large que la base du prothorax, rembruni. Elytres faiblement arqués à la base, brièvement arrondis aux épaules, alors environ deux fois plus larges que le prothorax à la base, ovales, à peine visiblement élargis sur les côtés, arrondis ensemble au sommet, presque deux fois plus longs que larges ensemble dans leur plus grande largeur, ponctués-striés, stries atténuées vers le sommet; intervalles des stries ponctuées plus larges que les points; stries suturales devenant contigues à la suture avant le sommet; marges latérales fortement infléchies, très étroitement rebordées. Sillon latéral des hanches antérieurs réduit à une strie, sa marge antérieure lisse. Métasternum longitudinalement sillonné, ponctué sur la région extérieure de la base. Hanches intermédiaires contigues. Premier segment de l'abdomen mesure dans sa plus grande longueur plus long que le métasternum.

18 exemplaires.

Loc. "Seychelles. Silhouette: from near Mont Pot-à-eau, ca. 1500 feet, VIII. 1908. Mare aux Cochons and forest above, over 1000 feet, IX. 1908*. Mahé: Cascade Estate, ca. 800 feet."

CRYPTAMORPHA Wollaston, 1854, Ins. Mader., p. 156.

14. *Cryptamorpha desjardinsi* (Guérin).

Psammœcus desjardinsi Guérin, 1838, Iconog. Règne Anim., Ins., p. 196.

Cryptamorpha desjardinsi C. O. Waterhouse, 1876, Ent. Month. Mag., xiii, p. 122; Casey, 1884, Trans. Amer. Ent. Soc., xi, p. 104, pl. 8, fig. 8; Grouvelle, 1908, Ann. Soc. Ent. France, lxxvii, p. 474.

Dendrophagus suturalis White, 1846, Voy. Ereb. Terr., Ent., p. 18; (Broun) 1880, Manual N. Zeal. Col., p. 222.

Cryptamorpha musæ Wollaston, 1854, Ins. Mader., p. 157, pl. 4, fig. 1.

Pseudophanus signatus Leconte, 1859, Proc. Acad. Philad., p. 85.

Telephanus fasciatus Redtenbacher, 1867, Reis. Novara, ii, p. 41.

Cosmopolite. Transporté avec les bananes.

6 exemplaires.

Loc. "Seychelles. Mahé: 5 of the specimens are from country near Morne Blanc and above Port Glaud, a rather dry scrubby area with a mixture of imported and endemic vegetation, 500—1000 feet, XI. 1908; the sixth is from the district of Mare aux Cochons, ca. 1500 feet, I.—II. 1909."

Inopeplini.

INOPEPLUS Smith, List. Col. British Museum, 1851, p. 4.

Ino Cast., Etud. Ent., 1835, p. 135.

Euryplatus Motsch., Etud. Ent., viii. 1859, p. 95.

Pseudino Fairm., Ann. Soc. Ent. France, 4 sér., ix. 1869, p. 208.

* In Silhouette certain *Psammœcus* were taken among the leaves of felled *Verschaffeltia*-palms, but I have no record of exactly which species were thus found. See p. 144, under *Lœmophlœus propior*.—H. SCOTT.

15. *Inopeplus mimetes*, n. sp.

Elongato-ovatus, depressus, nitidus, glaber, nigro-piceus; antennis rufo-piceis, præcipue apicem versus modicissime infuscatis; pedibus quam antennis dilutioribus; singulo elytro ad basin oblique et juxta apicem stricte testaceo-maculato, callo humerali nigro. Antennæ subelongatæ; 2° articulo sesquilongiore quam latiore, quam 3° breviore, articulis 4°—10° subquadratis. Caput convexiusculum, sat dense punctatum, antice juxta antennarum bases transversim truncatum, medio productum et parallelum, apice truncatum. Prothorax transversus, cordiformis, plus minusve parce punctatus; lateribus undulatis, obtusissime dentatis. Elytra apicem versus ampliata, longiora quam simul in maxima latitudine latiora, lævia. Long. 2·5—3·5 mill.

Ovale, environ quatre fois plus long que large dans sa plus grande largeur, déprimé, glabre, brillant, brun noirâtre; antennes roux testacé, légèrement assombries, surtout vers l'extrémité; pattes roux testacé; chaque élytre marqué à la base d'une tache testacée, oblique, partant de l'épaule, et au sommet d'une étroite bordure de même couleur; calus huméraux bruns. Antennes assez allongées chez le mâle, plus courtes chez la femelle; 1er article plus long que large, arqué en dehors, 2me plus long que large surtout chez le mâle, plus court que le 3me, 4me et 5me subégaux nettement allongés chez le mâle, un peu allongés chez la femelle, 6me plus long que 5me et 7me, 7me à 11me progressivement et très faiblement épaissis, 7me à 10me nettement allongés chez le mâle, suballongés chez la femelle, 11me à peine plus long que le précédent. Tête à peine plus courte que large, rétrécie transversalement en avant des naissances des antennes, puis subparallèle et tronquée au bord antérieur; front légèrement convexe, plus ou moins densement ponctué, séparé de l'épistome par une strie; épistome légèrement infléchi, environ trois fois plus large que long, marqué de quelques points; labre bien visible, arrondi au sommet, pointillé; yeux latéraux, saillants; tempes allongées. Prothorax cordiforme, plus étroit dans sa plus grande largeur que la tête, même chez la femelle, fortement rétréci à la base, moins de deux fois plus large dans sa plus grande largeur que long, plus ou moins éparsement ponctué; bords latéraux largement et très obtusement dentés; base subtronquée, rebordée, denticulée aux extrémités. Ecusson petit, subdemicirculaire. Elytres tronqués à la base, arrondis aux épaules, alors à peu près aussi larges que le prothorax dans sa plus grande largeur, s'élargissant presqu'en ligne droite vers le sommet, arrondis séparément à l'extrémité, nettement plus longs que larges dans leur plus grande largeur, presque deux fois plus larges dans leur plus grande largeur qu'à la base, lisses. Hanches antérieures faiblement écartées, postérieures médiocrement. Espèce voisine comme ensemble de *T. pictus* Cast. de Madagascar.

10 exemplaires.

Loc. "Seychelles. Silhouette: from high forest, near Mont Pot-à-eau, ca. 1500 feet, and above Mare aux Cochons, VIII.—IX. 1908. Mahé: forest above Cascade Estate, ca. 1000 feet, 1908—9."

Prostominini.

L'étude de la larve du *Prostominia convexiuscula* Grouvelle, que M. de Peyerimhoff a bien voulu donner dans ce mémoire, montre l'opportunité de l'établissement de cette nouvelle tribu, qui au milieu des Cucujidæ comprend des formes relativement anciennes*.

La nouvelle tribu des Prostominini nous semble avoir certains rapports avec les *Xenoscelis*.

Prostominia Reitter, 1889, Wien. Ent. Zeit., viii, p. 315.

16. *Prostominia scotti*, n. sp. (Fig. 4).

Elongata, subparallela, subdepressa, nitida, glabra, atra ; antennis, bucca pedibusque nigro-piceis. Caput fronte fere depressum, in disco parce subtiliterque utrinque fere dense punctatum. Prothorax antice vix, postice sat valde angustatus, lateribus arcuatus, vix ampliatus, paulo longior quam latior, parce subtiliterque punctatus, marginibus lateralibus subabrupte inflexus ; angulis omnibus obtusis ; basi truncata. Scutellum semicirculare, læve. Elytra humeris breviter rotundata, apice conjunctim stricte rotundata, circiter 3 et $\frac{1}{2}$ longiora quam simul latiora, striato-punctata ; striis circiter post medium evanescentibus, punctis apicem versus attenuatis ; striarum intervallis in disco quam punctis duplo latioribus. Long. 4—4·5 mill.

Subparallèle, environ cinq fois et demie plus long que large, subdéprimé, brillant, glabre, noir avec les antennes, la bouche et les pattes bruns de poix. Antennes atteignant environ le milieu de la longueur du prothorax chez le mâle, un peu plus courtes chez la femelle : massue environ deux fois plus épaisse que les articles précédents. Tête un peu plus longue que large, subdéprimée sur le front, infléchie faiblement en arc et déprimée en avant des bases des antennes, éparsement et très finement pointillée sur le disque, chargée sur les marges latérales du front de points plus forts, un peu allongés, parfois formant presque des strioles, dessinant presque des lignes longitudinales, épistome presque lisse, très largement arrondi au bord antérieur ; tempes moins de deux fois plus longues que le diamètre longitudinal de l'œil. Prothorax à peine rétréci en avant, assez fortement à la base, arrondi sur les côtés, surtout dans la partie basilaire, à peine élargi, un peu plus long que large, à peine plus étroit dans sa plus grande largeur que la tête avec les yeux, éparsement et très-finement pointillé, déprimé sur le disque, brusquement plié sur les marges latérales ; angles antérieurs obtus, postérieurs encore plus ouverts ; base tronquée, marge basilaire coupée longitudinalement par un sillon à peine marqué. Ecusson presqu'en forme de demi-cercle, lisse. Elytres tronqués à la base, brièvement arrondis aux épaules, à peine arqués et élargis sur les côtés, brièvement arrondis au sommet, environ trois fois et demie plus longs que larges ensemble dans leur plus grande largeur ; ponctués-striés surtout sur la moitié basilaire, puis ponctués en lignes et enfin points s'atténuant vers l'extrémité ; intervalles des stries presque plans, environ deux

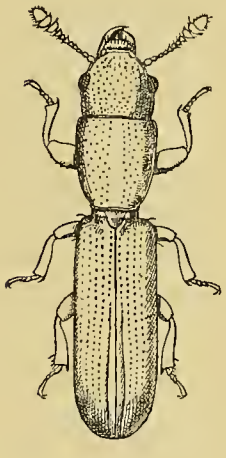


Fig. 4.
Prostominia scotti, n. sp., × 16.

* Voir l'étude de M. de Peyerimhoff, p. 156.

fois plus larges que les points ; stries suturales entières, bien marquées vers le sommet ; marges latérales brusquement pliées.

9 exemplaires.

Loc. " Seychelles. Mahé : from forest near Morne Blanc, XI. 1908."

17. *Prostominia convexiuscula*, n. sp. (Fig. 5, tête).

Elongata, subparallela, convexiuscula, nitida, glabra, atra ; femoribus tibiisque nigro-piceis, antennis tarsisque dilutioribus. Caput fronte subdepressum, in disco parce subtiliterque, utrinque densius, punctatum, inter antennarum bases biimpressum ; epistomo valde producto. Prothorax postice angustatus, lateribus subrectus, transversus ; margine antico medio truncato, ad extremitates arcuato, angulis anticis posticisque obtusis ; basi arcuata ; disco præcipue ad latera subdense et quam capite densius punctulata. Scutellum semicirculare, testaceo-piceum. Elytra humeris breviter rotundata, apice conjunctim rotundata, paulo magis 2 et $\frac{1}{2}$ longiora quam simul latiora, striato-punctata ; striis fere integris, intervallis in disco quam punctis vix latioribus. Long. 3—3·5 mill.

Subparallèle, environ quatre fois et demie plus long que large, faiblement convexe, glabre, brillant, noir ; tibias et fémurs bruns de poix, antennes, tarses et écusson, surtout les deux derniers, plus clairs. Antennes courtes même chez le mâle ; massue moins de deux fois plus épaisse que les articles précédents. Tête plutôt plus large que longue, faiblement convexe sur le front, sans infléxion à la base de l'épistome, biimpressionné entre les naissances des antennes, éparsement et très finement pointillée sur le disque, chargée sur les marges latérales du front de points plus forts ; épistome lisse, très saillant ; front longitudinalement substrié ; tempes au moins égales au double du diamètre longitudinal de l'œil. Prothorax rétréci à la base, presque droit sur les côtés, assez fortement arqué en avant au bord antérieur, arqué à la base, environ une fois et demie plus large dans sa plus grande largeur que long dans sa plus grande longueur, un peu plus étroit dans sa plus grande largeur que la tête avec les yeux ; en angle obtus à tous les angles, éparsement et finement pointillé, coupé dans la longueur, surtout vers la base, par une très vague impression ; marges latérales brusquement pliées, sauf contre l'angle antérieur ; bords latéraux vers le côté droits, fortement arrondis vers la base, celle-ci tronqué, tous les deux finement rebordés. Ecusson presque demi-circulaire, lisse. Elytres tronqués à la base, arrondis aux épaules, subparallèles, arrondis ensemble au sommet, un peu plus de deux fois et demie plus longs que larges ensemble, ponctués-striés, presque jusqu'à l'extrémité ; intervalles des stries à peine plus larges sur le disque que les points des stries ; marges latérales et apicales assez brusquement infléchies-pliées.

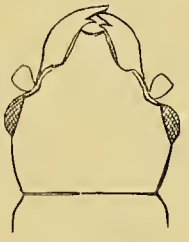


Fig. 5. *Prostominia convexiuscula*, n. sp.

94 exemplaires.

Loc. Seychelles. Silhouette, Mahé.

" The great majority of this long series were found in Silhouette, in the forest immediately above Mare aux Cochons plateau, under the bark of fallen twigs of an endemic forest-tree, the ' Bois Rouge ' (*Wormia ferruginea*) : they were taken thus several times between 6. IX. and 19. IX. 1908, and on certain occasions the larvæ and

pupæ discussed on pp. 156—159 of this memoir were found in company with adults. In Mahé 9 specimens were collected, all from the high damp forest: Morne Blanc and Pilot, XI. 1908; between Trois Frères and Morne Seychellois, 1500—2000 feet, XII. 1908; above Cascade Estate, I. 1909.—H. Scott."

Cryptophagidæ. Xenoscelini.

Hapalips Reitter, 1877, Verh. nat. Ver. Brünn, xv, p. 122 (Rhizophagidæ); Gorham, 1898, Biol. Centr.-Amer., Col. vii, p. 250 (Erotylidæ); Grouvelle, 1908, Ann. Soc. Ent. France, lxxvii, p. 58 (Cryptophagidæ); Champion, 1913, Trans. Ent. Soc. London, p. 96 (Cryptophagidæ).

18. *Hapalips championi*, n. sp.

Elongato-ovatus, modice convexus, nitidus, glaber, fulvo-testaceus antennis pedibusque dilutioribus. Caput transversum, convexiusculum, subdense punctulatum, utrinque ad antennæ basin oblique tenuiterque striolatum, temporibus retrorsum divergentibus, minimis, angulis posticis vix hebetatis. Prothorax modice transversus, lateribus extra extremitates vix arcuatus; angulis anticis rotundatis, posticis acutis; basi medio arcuato-producta, utrinque sinuata; lateribus basique tenuiter marginatis. Elytra basi subparallela, dein apicem versus attenuata, apice separatim breviter rotundata, striato-punctata; punctis apicem versus attenuatis et evanescentibus; striis suturalibus paulo ante apicem magis impressis, intervallis striarum in disco quam punctis paulo latioribus. Mesosternum subparce punctulatum. Metasternum in longitudinem vix perspicue sulcatum, subdense punctulatum. Segmenta abdominis parce et tenuissime punctulata. Long. 3·5 mill.

Ovale, un peu moins de cinq fois plus long que large dans sa plus grande largeur, modérément convexe, brillant, glabre, testacé, teinté de nuance de poix; antennes et pattes plus claires. Antennes atteignant à peine le milieu du prothorax; 3me article subcarré, 4me, 6me et 8me plus courts que les articles voisins, 7me et 8me un peu plus larges que les articles précédents; massue brusque, environ deux fois plus large dans sa plus grande largeur que les articles 7 et 8. Tête subtriangulaire, environ deux fois plus large que longue, faiblement convexe, couverte d'une ponctuation fine, presque dense, s'atténuant en avant, infléchie, arquée en avant des bases des antennes, très-largement arrondie au bord antérieur, yeux plus de deux fois plus longs que larges; tempes petites convergentes en avant, angles postérieurs à peine émoussés. Prothorax médiocrement transversal, subparallèle, très-faiblement arqué sur les côtés, sauf aux extrémités, brièvement arrondi aux angles antérieurs, brièvement arqué, sinué en avant des angles postérieurs, ceux-ci aigus, presque saillants; base arquée en arrière dans le milieu; bords latéraux et base étroitement rebordés. Ecusson subpentagonal, plus de deux fois plus large que long. Elytres un peu plus larges à la base que la base du prothorax, subdentés aux épaules, subparallèles sur plus de la moitié basilaire, puis atténués vers l'extrémité, brièvement et séparément arrondis au sommet, environ trois fois et demie plus longs que larges ensemble à la base, ponctués-striés; stries atténuées, puis effacées vers le sommet; stries suturales mieux marquées vers l'extrémité, très atténuées sur

l'extrême marge apicale; intervalles des stries discoidales plus larges que les points; bords latéraux bordés par une marge concave, étroite à la base, s'élargissant faiblement vers le sommet et s'effacant un peu avant de l'atteindre. Mésosternum à peine visiblement alutacé, subéparsement ponctué. Métasternum à peine visiblement sillonné dans la longueur, presque densement ponctué. Segments de l'abdomen éparsement et très finement ponctués surtout vers l'extrémité. Lignes fémorales du premier segment courtes, divergentes.

3 exemplaires.

Loc. "Seychelles. Praslin: from between the leaf-bases of a growing endemic palm-tree, a ♂ *Lodoicea sechellarum* ('Coco-de-mer'), in the Vallée de Mai, Côtes d'Or Estate, 28, XI. 1908."

19. *Hapalips scotti*, n. sp. (Fig. 6).

Elongatissimo-ovatus, modice convexus, nitidus, glaber, piceus, antennarum basi et ultimo articulo pedibusque dilutioribus. Caput transversum, convexiusculum, parce punctulatum, punctis apicem versus attenuatis, temporibus parallelis, minimis, angulis posticis hebetatis. Prothorax subquadratus, capite paulo latior, subparce punctulatus; lateribus basique tenuiter marginatis. Elytra apicem versus attenuata, tenuiter punctato-substriata, punctis ad apicem attenuatis; stria suturali ad apicem magis impressa, intervallis striarum in disco quam punctis latioribus, juxta apicem haud separatis et calloso-elevatis. Mesosternum alutaceum, subparce punctatum. Metasternum alutaceum, subparce punctulatum. Segmenta abdominis tenuiter alutacea et parce tenuissime punctulata. Long. 3—4 mill.

Ovale, plus de cinq fois plus long que large dans sa plus grande largeur, modérément convexe, brillant, glabre, brun de poix avec la base et le dernier article des antennes et les pattes plus clairs. Antennes atteignant à peine le milieu de la longueur du prothorax; 3me article subcarré; 4me, 6me et 8me plus courts que les articles voisins; 7me et 8me très faiblement plus larges que les précédents; massue brusque, un peu moins de deux fois plus large que l'article 8. Tête modérément transversale, faiblement convexe, couverte d'une ponctuation presque dense, très fine à la base, s'atténuant vers l'épistome, celui-ci infléchi, tronqué au bord antérieur; yeux plus de deux fois plus longs que larges; tempes parallèles, courtes; angles postérieurs émoussés. Prothorax subcarré, très légèrement arqué sur les côtés, couvert d'une ponctuation dense et très fine, entremêlée de points encore plus fins visibles à un fort grossissement, légèrement relevé au milieu de la base; angles antérieurs et postérieurs faiblement obtus, les premiers à peine émoussés; côtés et base très finement rebordés. Ecusson environ deux fois plus large que long, subpentagonal. Elytres brièvement arrondis aux épaules, progressivement et faiblement atténués vers l'extrémité, très brièvement arrondis séparément au sommet, environ quatre fois plus longs que larges à la base, finement ponctués-striés; stries suturales enfoncées vers le sommet; stries discoidales anténuées vers l'extrémité, effacées au sommet; marges latérales fortement infléchies,

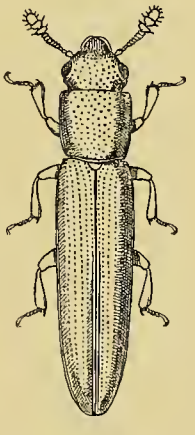


Fig. 6.

Hapalips scotti, n. sp., × 16.

bordées par une strie bien marquée, limitant en dedans une marge explanée très étroite, un peu plus large au sommet ; disque de chaque élytre terminé au sommet par un calus allongé, subacuminé à l'extrémité, limité en dedans par le fort enfoncement de la strie suturale, se raccordant en dehors et au sommet en pente très brusque avec le rebord marginal. Mésosternum et métasternum finement alutacés, éparsement et finement ponctués, le premier plus fortement que le second. Segments de l'abdomen à peine visiblement alutacés, éparsement et très finement pointillés. Lignes fémorales du premier segment légèrement divergentes, atteignant à peine le milieu de la longueur du segment.

28 exemplaires.

Loc. Seychelles. Silhouette, Mahé.

"In Silhouette (VIII.—IX. 1908) a number of specimens were beaten from a dead leaf of a coconut-palm still hanging to the tree, at the edge of the Mare aux Cochons plateau ; others were taken in the forest above Mare aux Cochons, one being recorded as found among leaves of a felled *Verschaffeltia*-palm (see under *Læmophlœus propior*, p. 144) ; another was found between leaf-bases of a growing endemic palm (species unrecorded) in the high damp forest near Mont Pot-à-eau. In Mahé two specimens were taken between leaf-bases of a growing endemic palm (*Stevensonia*) near Morne Blanc, X.—XI. 1908 ; several others were collected in the forest above Cascade Estate."

DESCRIPTION DE LA LARVE ET DE LA NYMPHE DE *PROSTOMINIA CONVEXIUSCULA* GROUVELLE*, [COLEOPTERA, CUCUJIDÆ]. PAR P. DE PEYERIMHOFF.

(FIGURES A—F DANS LE TEXTE.)

Matériel étudié : (1) quatre larves de même âge, conservées dans l'alcool faible ; toutes ont les téguments distendus et sont proches d'une mue : la cuticule déjà soulevée laisse apercevoir le stade suivant, à peine chitinisé.—(2) une nymphe déformée par le séjour dans l'alcool.—(3) un imago.

Provenance (d'après une étiquette manuscrite jointe) : " Seychelles. Silhouette : Mare aux Cochons, from under bark of fallen twigs of ' Bois Rouge ' (*Wormia ferruginea*), IX. 1908 (see p. 153)."

Longueur de la larve la mieux conservée : 3·5 mill.—Largeur : 0·4 mill.

Corps (fig. *A*) très allongé, parallèle, déprimé, luisant, presque lisse, jaunâtre ; mandibules et dernier segment d'un roux foncé. *Ocelles* noirs. Soies claires, peu nombreuses et courtes.

Tête à peine enchâssée dans le prothorax, légèrement élargie en arrière, puis un peu rétrécie à la base. Sutures crâniennes jalonnées par une assez large dépression en V. *Epistome* défini par une ligne postérieure nette. *Labre* (fig. *C*) membraneux, saillant en arc de cercle, et portant de fines soies.

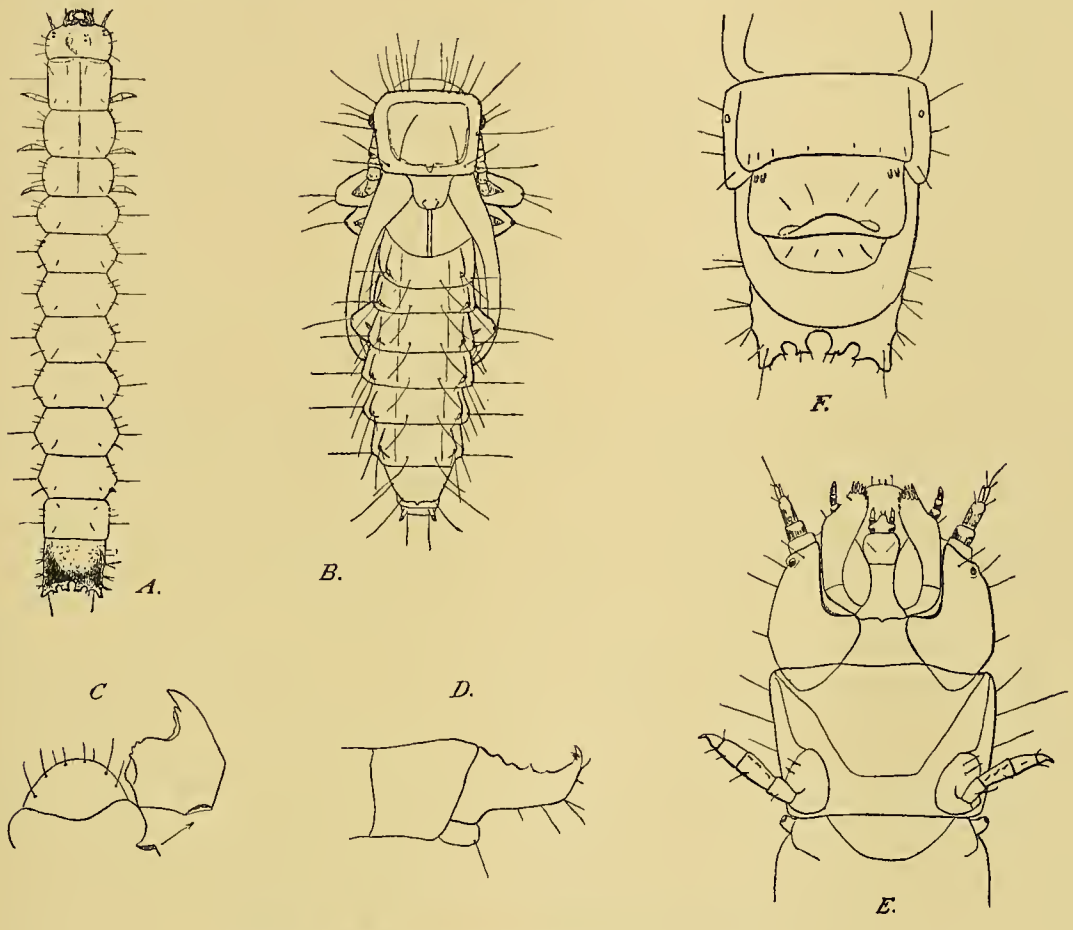
Antennes relativement courtes, basées sur une articulation membraneuse très détachée. 1er article carré, 2me subcylindrique et sensiblement plus long, 3me deux fois plus court et plus mince que le précédent, prolongé par une longue soie ; cône sensitif de même longueur et de largeur presque égale.

* Voir pp. 152—154.

Mandibules (fig. *C*) larges et courtes, saillantes, bidentées au sommet, avec une mola distincte, denticulée de profil.

Pleures céphaliques (fig. *E*) non contigues, creusées dans leur moitié antérieure en forme de rectangle émoussé, pour recevoir les pièces buccales dont l'ensemble est plat.

Maxilles formées d'un stipe robuste, peu incliné, prolongé sans suture par un lobe presque rectangulaire, armé à l'intérieur et surtout au sommet d'un double peigne de spinules. *Palpes maxillaires* dépassant beaucoup le labium, à articles diminuant en



Figs. *A—F.* *Prostominia convexiuscula* Grouv.

A. Larve, vue en dessus.
B. Nymphe, vue en dessus.
C. Mandibule droite (légèrement détachée) et labre, vus en dessus.
D. Les deux derniers segments de l'abdomen, vus de profil.
E. Tête et prothorax, vus en dessous.
F. Derniers segments de l'abdomen, vus en dessous.

largeur et croissant en longueur, les deux premiers aussi longs que larges, le dernier presque une fois et demie plus long que le précédent. *Cardo* visible en partie, enraciné sous la membrane articulaire qui est longuement ovale et rejoint le menton vers la moitié.

Labium composé d'avant en arrière: (1) d'un *palpigère* cordiforme portant sur des socles assez détachés un *palpe* court, à 2me article cylindrique terminé par une papille;

au milieu, une *languette* arrondie, portant deux soies terminales.—(2) d'un *menton* subcarré, orné de deux soies.—(3) d'un *sous-menton* en forme d'enclume, entièrement contigu à la membrane articulaire des maxilles et s'appuyant en arrière sur une *gula* de contour semblable, mais plus large, qui fait le pont entre les genæ.

Segments thoraciques à côtés dorsaux peu curvilignes, présentant chacun en leur milieu un sillon longitudinal très prononcé, et munis latéralement d'une assez longue soie insérée sur la pleure. Pronotum en rectangle transversal de même largeur que la tête, portant quatre soies en avant et en arrière. Mésonotum et métanotum légèrement plus courts et plus larges, portant deux soies antéro-latérales et quatre soies postérieures.

Segments abdominaux transversaux, à côtés curvilignes subanguleux, de longueur croissante du 1er au 5me inclusivement ; 6me et 7me subégaux, 8me plus long et moins large, en trapèze renversé ; chacun portant des soies à peu près disposées comme sur le métanotum. 9me segment (fig. *F*) carré dans son ensemble, très chitinisé, rugueux, convexe sur sa moitié antérieure, puis profondément déclive, chevronné sur les côtés, et terminé par quatre processus chitineux, les latéraux bidentés à dent externe très relevée (fig. *D*), les médians en forme de crochets affrontés vers la ligne médiane, où ils enclosent une espace circulaire.

Dessous du corps déprimé, luisant et de même consistance que le dessus. Pleures détachées. Sternite du 9me segment très saillant en dessous, débordant en avant sur le 8me, armé de chaque côté vers la base de deux papilles chitineuses aigues. Anus faisant suite vers l'arrière, précédé et suivi de quatre soies.

Stigmates normaux, la première paire grande, saillant entre les deux premiers segments du thorax; les autres paires latérales, non saillantes, situées au premier tiers des pleures, sur les 8 premiers segments de l'abdomen.

Pattes distantes, courtes, portant quelques rares spinules. *Hanches* globuleuses, *trochanters* plus courts que les *fémurs*, égaux en longueur aux *tibias*, qui sont plus minces, tronçoniques, et terminés par un *ongle* aigu à base membraneuse.

Cette larve a le facies et la structure de toutes celles connues dans la famille des *Cucujidæ* : corps long, aplati, terminé par des processus compliqués ; organes buccaux inférieurs, mais non saillants, et relativement réduits, c'est-à-dire laissant, entre le trou occipital et le niveau du cardo, une gula et des genæ étendues.

La forme épanouie et la structure membraneuse du lobe maxillaire rappellent beaucoup le type *Inopeplus* (cf. Peyerimhoff, in *Annales de la Société entomologique de France*, 1902, p. 715). Mais *Prostominia* s'en distingue profondément par le développement plus accentué des pièces buccales, le 8me segment plus court, le 9me beaucoup plus long, terminé par un système chitineux totalement différent. Tous ces caractères marquent a priori une moindre différenciation. Au cas où la structure de l'imago inclinerait à rapprocher ces deux genres, c'est en tous cas *Prostominia* qui représenterait la forme phylétiquement la plus ancienne.

Nymphe (fig. *B*) membraneuse, nue, pâle, terminée par des cerques, surtout caractérisée par ses très longues soies motrices. De chaque côté, la tête en porte 6, savoir : une sur l'épistome, 2 sur le front, 2 au-dessus de l'œil, et une sur le vertex,—le pronotum 10, savoir : 4 au bord antérieur, 4 au bord latéral, les deux postérieures rappro-

chées de l'angle, et 2 discales proches de la base,—les segments dorsaux de l'abdomen 4 (sauf le dernier qui n'en porte que 2), savoir : une latérale sur le tubercule de la pleure, 2 de taille différente sur le rebord interne de la pleure, et une dorsale,—au genou, les fémurs antérieurs 2, les médians et les postérieurs une.

La forme de la tête et du pronotum (dont le disque est très déprimé), ainsi que la striation des élytres si accentuée chez l'imago, sont déjà très sensibles. Les antennes sont chargées de tubercles.

No. III.—MALLOPHAGA, APHANIPTERA, AND DIPTERA PUPIPARA.

By Hugh Scott, M.A., F.L.S., F.E.S.,

Curator in Entomology in the University of Cambridge.

(Text-figures 1—4.)

Read 18th June 1914.

MALLOPHAGA.

Only one species of bird-louse was obtained by the Percy Sladen Trust Expedition. Through the kindness of Professor G. H. F. Nuttall it was submitted to Professor L. G. Neumann of Toulouse, to whom its determination is due.

Lipeurus, Nitzsch.

1. *Lipeurus subsignatus*, Giebel.

Lipeurus subsignatus Giebel, Ins. Epiz., 1874, p. 232.

Loc. Aldabra: a number of specimens were collected by Fryer from the flamingo *Phœnicopterus minor*, 1908—9. Professor Neumann stated (in. litt.) that this species was already known as a parasite of *Phœnicopterus*: Kellogg, in Gen. Ins., Fascic. 66, 1908, p. 45, gives it "from *Phœnicopterus antiquorum*."

APHANIPTERA.

A single species of flea is included in the collections of the Expedition. I am indebted to the Hon. N. C. Rothschild for its determination.

Ctenocephalus, Kolenati.

2. *Ctenocephalus felis* (Bouché).

Pulex felis Bouché, Nova Acta Acad. Leopold., xvii. 1835, p. 505.

Loc. Seychelles. A number of specimens were obtained in Silhouette, IX. 1908, in the hut at Mare aux Cochons: there were no other human habitations near, but the thick palm-leaf thatch of the hut was tenanted by many rats. A single specimen was also collected in Mahé (Cascade Estate, II. 1909).

DIPTERA PUPIPARA.

Hippoboscidæ.

Only two species of this family are represented in the collections formed by the members of the Expedition. Both are found all over the warmer parts of the globe. I am

much indebted to Mr E. E. Austen of the British Museum for examining and determining the material.

PSEUDOLFERSIA, Coquillet.

3. *Pseudolfersia spinifera* (Leach).

Feronia spinifera Leach, Eprobosc. Ins., ii. 1818, p. 557, pl. 26, figs. 1—3.

Pseudolfersia spinifera Speiser, Zeitschr. Hym. Dipt., ii. 1902, p. 146; Austen, Ann. Mag. Nat. Hist., ser. 7, xii. 1903, p. 265.

It is not attempted here to give the complete synonymy of this very wide-spread species. Its association with the Frigate-bird, which is found on the islands and coasts of all the warmer parts of the world, both tropical and subtropical, is discussed by Speiser (*l.c.*), and mentioned again by Austen (*l.c.*). The latter writer also refers to some other species of birds on which the fly has been found.

The collections of the Percy Sladen Trust Expedition include seven specimens. Four examples from Aldabra are very much larger than three from the Cargados Islands, but the disparity in size is no greater than that visible among the specimens of the British Museum series.

Loc. Aldabra: 1907 (Thomasset). Cargados Carajos Islands, 26 and 28. VIII. 1905. Hosts unrecorded.

LYNCHIA, Weyenbergh.

4. *Lynchia maura* (Bigot).

Olfersia maura Bigot, Ann. Soc. ent. France, ser. 6, v. 1885, p. 237.

Lynchia maura Speiser, Zeitschr. Hym. Dipt., ii. 1902, pp. 155, 163.

A single specimen has been determined by Mr Austen as belonging to this species, which, he informs me, is a parasite of domestic pigeons in all subtropical and tropical parts of the world.

Loc. Seychelles: Mahé, 1908—9 (no further data recorded).

Nycteribiidæ.

No members of this family of bat-parasites were found in the Seychelles, nor, so far as I am aware, have any previously been recorded from the group. It must be confessed, however, that very little search was made for Nycteribiidæ. A specimen of the flying-fox *Pteropus edwardsi* was shot in Silhouette in August 1908, and one of *Colëura seychellensis* was shot at night at Cascade, Mahé, by Fryer, on March 1st, 1909. Neither of these specimens bore any Nycteribiidæ: but no further search was made, and the resting-places of bats were not discovered. This branch of the entomology of the Seychelles, therefore, should decidedly be further investigated.

As regards Aldabra and the neighbouring coral-islands the case is different. There Fryer did search for Nycteribiidæ, and he succeeded in finding one interesting species. The bat-fauna of those islands is mentioned in his work on the "formation of Aldabra," etc. (Trans. Linn. Soc. London, ser. 2, Zool., vol. xiv. 1911, pp. 416—7). There is an endemic flying-fox, *Pteropus aldabrensis* True, confined to Aldabra, i.e. not occurring

in the neighbouring islands of Assumption, Cosmoledo, or Astove. Fryer tells me that he examined 12—16 specimens of this bat for Nycteribiidæ, but found none, which is remarkable, since in Ceylon and the East Indies bats of this genus appear often to harbour these parasites. The single species of Nycteribiidæ collected was taken in Assumption Island on a wide-ranging bat, *Taphozous mauritianus*. The following particulars of its capture have been given me. The bats were clinging to the stem of a big coconut-palm —the only big one in the island—just below the crown of leaves. A boy was sent up the tree, but though it was broad daylight the bats were very active and dodged him round the trunk. Two of them were, however, killed with a stick, and on these were found the 18 specimens of the Nycteribiid, which were also very active.

Of the other family of Dipterous bat-parasites, the **Streblidæ**, none were obtained in any of the islands visited by the Percy Sladen Trust Expedition, nor have any been previously recorded therefrom.

Nycteribia, Latreille. Subgenus Acrocholidia (Kolenati).

The single species belongs to this genus and subgenus: that is, it is entirely without eyes; its tibiæ are not ringed, nor are they broad and flattened; the anal segment of the ♀ is without dorsal appendages.

This Nycteribiid is quite distinct from any species of which I have seen named specimens, and it does not agree with any published description. It is therefore described here as new, and dedicated to its finder under the name *Nycteribia* (*Acrocholidia*) *fryeri*. It has not been possible for me to see the types or named specimens of a number of species of the subgenus. Had this been possible, it would certainly have been more satisfactory to have had examples of all species for comparison, particularly as the descriptions in some cases are far from complete. According to Speiser's descriptions (Arch. Naturg., 67.1.1901, pp. 31—36) both *N.* (*A.*) *stichotricha* Speiser from Nias Island, and *N.* (*A.*) *bellardii* Rondani from South America, seem to have certain points of resemblance with *N.* (*A.*) *fryeri*, but both appear to differ from it in other respects. The most striking feature of *N.* (*A.*) *fryeri* lies in the form of the dorsal abdominal segments of the ♀; and in no description have I found reference to anything like its remarkable two-processed 2nd tergite.

In any case, *N.* (*A.*) *fryeri* is not confined to the region where it was found by Fryer, since there is in the British Museum an old, dried (and previously unnamed) ♀ specimen, undoubtedly referable to this species, from the widely remote island of Labuan.

5. *Nycteribia* (*Acrocholidia*) *fryeri*, sp. nov. (figs. 1—4).

Length of body (without head) between $2\frac{1}{4}$ and $2\frac{1}{2}$ mm. *Colour* of chitinous parts yellowish, abdomen of ♂ darker. *Head* with about 6 bristles on the vertex in front (the complete absence of eyes has been demonstrated by mounting the head of a specimen in balsam and examining it under a high power). *Thorax beneath* (fig. 2) a little broader than long: of three specimens (preserved in spirit) in which its dimensions were measured with the help of a drawing apparatus, in 1 ♂ the breadth is about $1\frac{1}{7}$ times the length, in 2 ♀ it appears about $1\frac{1}{5}$ times the length: the median longitudinal line is slightly

broadened just behind the middle, and is depressed rather abruptly just before its posterior end: the oblique sutures dividing meso- from metasternum appear as rather broad white lines: the surface bears extremely fine short bristles and there are no very long bristles on the hind margin. *Legs* very long and slender, front coxæ over $\frac{1}{3}$ the length of the femora.

♂ ABDOMEN (figs. 3, 4): at the extreme base dorsally is a number of short erect

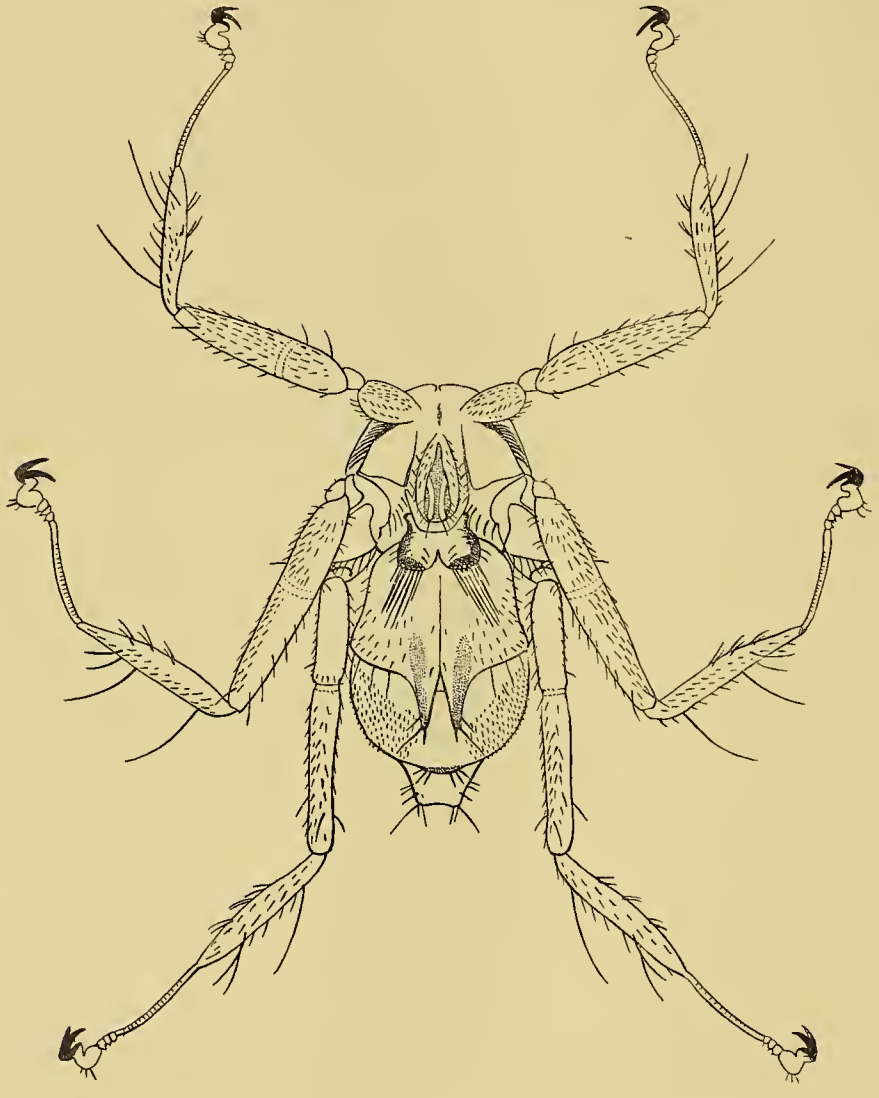
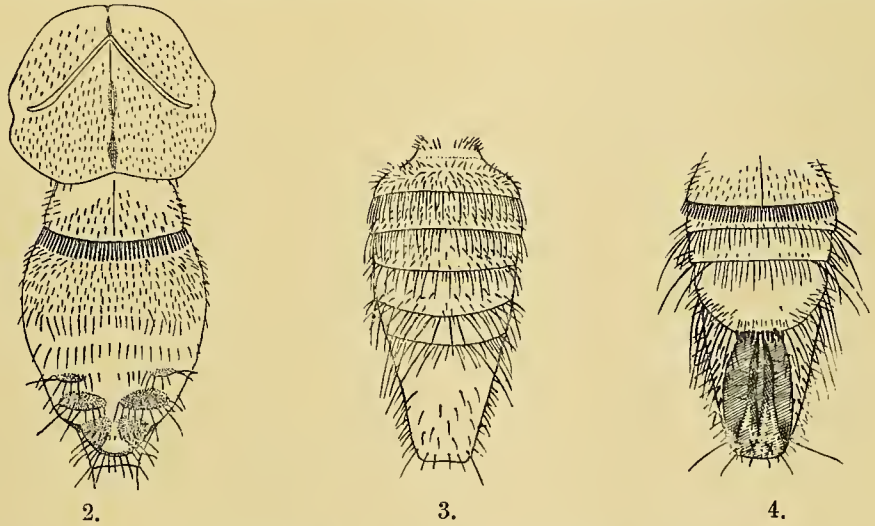


Fig. 1. *Nycteribia* (*Acrocholidia*) *fryeri*, sp. nov., ♀, dorsal view.

bristles marking the hind margin of the true *tergite* 1. *Tergites* 2, 3, 4 have their surfaces clothed with short bristles, and their hind margins set with alternating short and moderately long bristles, rather spaced out. *Tergites* 5 and 6 have their hind margins set with alternating very long and shorter bristles, the very long ones nearest the middle being strongly divergent: tergite 5 has a few short bristles on its surface, tergite 6 has its surface bare. *Anal segment* rather strongly tapering, its breadth at the apex a little less than $\frac{1}{2}$ that at the base; in fig. 3 its length appears about equal to its breadth at the

base, but when the segment is viewed from a slightly different angle its length appears a little greater than its breadth at the base: the anterior half of the segment is bare, but the posterior half bears a number of short erect bristles: there are numerous rather longer erect bristles on its sides, and there is a long stout bristle at either apical angle. Ventrally (fig. 4), the *basal sternite* is bare towards its base, but has several irregular series of short bristles on its surface behind, and rather longer bristles, directed outwards, at the sides: teeth of the ctenidium rather long. *Sternites* 2 and 3 have alternating moderately long and shorter bristles on their hind margins, and at the hind angles several much longer bristles, of which one is very long and outstanding: the surface of sternite 2 is almost hidden under the ctenidium, but some very short bristles can be discerned on it: the surface of sternite 3 is bare except for a few very short bristles just in front of the hind margin: both sternites have a few rather longer bristles on their surfaces towards the lateral margins. The next *sternite* (4 + 5) is a plate as long as, or longer than, the two foregoing taken together; its margin is curved at either side, so that it forms roughly a trapezoidal figure: its surface is bare except for a narrow area immediately before the margin: the apical part of its margin bears a number of stout black thorn-like bristles, immediately in front of which is a series of very fine bristles, long and short alternating: the sloping parts of the margin on either side bear very long bristles, immediately in front of which (on the surface) are short erect bristles, and in front of these again some very short bristles. The *anal segment* is rather densely covered with stiff erect bristles: the *claspers* lie parallel but not contiguous, taper from base to apex, and are black-pigmented not only at the apex but throughout their length almost to the base.

The ♀ ABDOMEN dorsally (fig. 1) is very remarkable. *Basal tergite* small and narrow, frequently appearing much foreshortened owing to distension of the abdomen, narrower at



2. 3. 4.

Figs. 2—4. *Nycteribia* (*Acrocholidia*) *fryeri*, sp. nov. 2. ♀, thorax and abdomen, ventral. 3. ♂, abdomen, dorsal. 4. ♂, abdomen, ventral.

the base and broader behind, with the hind angles rounded; divided in the middle of the hind margin by a triangular cleft extending forwards about half its length, in which cleft

pale whitish connexivum is exposed; the hind margin on either side of this cleft is broadly, and the lateral margins are rather more narrowly, black-pigmented; the hind margin on either side of the cleft bears 5 or 6 very long strong blackish bristles set close together; on either side of these, at the outer angles, the margin bears 2 or 3 short blackish bristles and the disc of the tergite bears a number of short sub-erect bristles in its lateral portions. *Tergite* 2 large, yellowish, chitinous, occupying nearly half the length of the abdomen: divided longitudinally by a pale line which is not always very evident: the hind margin slopes obliquely backwards on either side to the middle line, immediately on either side of which the segment is produced into a remarkable blunt-pointed process: the two processes are slightly divergent, and separated from one another by an elongate triangular cleft. A streak of darker brown pigment extends along the outer side of each process some way forward into the segment; the two streaks diverge slightly from behind forwards, and each becomes broader and more dilute anteriorly until it is gradually lost in the surrounding yellow colour of the segment. Each of the processes bears several bristles; a long stout divergent bristle rises from its inner side just before the apex, there is a shorter bristle at the extreme apex and one or two still shorter ones near it. The hind margin of the segment bears 3 or 4 rather long bristles, spaced out, on either side towards the sides of the body. The disc of the segment bears scattered short erect bristles laterally, but the median portion, especially in front, is bare except for a very few short bristles on either side of the median longitudinal line. Behind this 2nd tergite is an area of whitish *connexivum*, bare in the middle, at the sides covered with numerous scattered minute and exceedingly short bristles. Behind this connexivum is a small, more strongly chitinised, yellowish portion, with a slightly rounded hind margin bearing 6 bristles, 3 on either side separated by a median interval*. The *anal segment* is short, tapering slightly, but rather broad apically: quite bare above, but with one or two bristles at either side, and a longer and a shorter one at each hind angle.

Ventrally (fig. 2), the *basal sternite* is as in the ♂. *Sternite* 2 consists of connexival membrane; surface rather closely covered with fine short bristles, becoming slightly longer behind; hind margin indicated by a transverse series of longer and stouter bristles, those towards the sides longer than the median ones. *Sternite* 3 consisting of a very short area of connexivum, its surface bare, its hind margin indicated by a series of bristles similar to that on sternite 2. *Sternite* 4 also short and with its surface bare: its hind margin has, at either lateral extremity, a small yellowish chitinous area: the marginal series of bristles is nearly similar to those on the two preceding sternites, except that on each of the two small chitinous areas two of the bristles are very long and directed outwards. *Sternite* 5 bears two much larger yellowish chitinous areas, which are separated in the middle line by only a very narrow space of white connexivum: each chitinous area bears a transverse series of short bristles in front of the hind margin, and a series of much longer bristles on the hind margin: in the marginal series longer

* In the British Museum specimen from Labuan this small chitinous area is much smaller and bears only two bristles. The specimen has long been preserved dry, and it is possible that other bristles may have been broken off. In other respects the Labuan example corresponds closely with those from Assumption.

and shorter bristles alternate, and one or two near the outer extremities are very long and directed outwards. *Subgenital plate* roughly trapezoidal, with hind angles much rounded : divided by a narrow, pale, median area into two yellowish chitinous lateral parts, each of which bears on its posterior half two transverse series of bristles, the anterior consisting of about 5 short bristles, the posterior consisting of about 3 very long outstanding bristles ; the apical part of the margin bears about 9 bristles, of which the two at the rounded hind angles are the longest.

Loc. Assumption. Labuan.

Assumption : IX. 1908 (Fryer) ; 3♂, 15♀ (1♂, 12♀, in spirit : 2♂, 3♀, preserved dry), collected from *Taphozous mauritianus* (for circumstances of capture see above in the general remarks on Nycteribiidæ).

Labuan : 1♀ in British Museum, labelled " 78.6. From *Taphozous saccolaimus.*"

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No. IV.—MEDUSÆ FROM THE INDIAN OCEAN.

(Collected by Prof. Stanley Gardiner, in H.M.S. "Sealark," in 1905.)

By Edward T. Browne, M.A., F.L.S.

Plate 39.

Read 17th June, 1915.

INTRODUCTION.

The collection of Medusæ, made by Prof. Stanley Gardiner during the voyage of H.M.S. "Sealark" in the Indian Ocean, between Chagos, Mauritius and Seychelles, in 1905, was sent to me for examination. I heartily thank Prof. Gardiner for allowing me the privilege of writing this report upon the specimens, and must also express to him my regret for the delay over the work.

The chief interest in the collection centres in the geographical distribution of species as this part of the Indian Ocean had scarcely been explored for medusæ. It should be borne in mind that the collecting of medusæ was only a subsidiary part of the expedition's work. Nevertheless Prof. Gardiner was able to collect not less than thirty-five different genera, but none proved to be new to Science. The species were slightly more numerous than the genera, three new ones have received names, and others could have been added if the specimens had been in better condition.

The Anthomedusæ show a much better list of genera and species than in the previous collections from the Maldives and Ceylon. The poor list of species belonging to the Leptomedusæ is partly due to my failure to identify the specimens. There are always a certain number of bad specimens in every collection, and it so happened that the Leptomedusæ got more than their fair share of these.

The Anthomedusæ and Leptomedusæ are associated with the littoral fauna and are rarely found far from land or shallow water. Many of their genera are known to be connected with hydroids, so that their geographical distribution depends upon their hydroids finding a suitable habitat. Some are widely distributed, others have a very limited range. It is certainly strange that some of the commonest species have so far evaded the search for their hydroids and leave us still without a clue, but it is difficult to presume that some have no alternation of generations.

It is unfortunate that systematists on medusæ still hold divergent views over the question of species, but nevertheless progress is slowly being made. There has been a good advance since the day that saw the appearance of Haeckel's monograph which was by no means a success, except from an artistic point of view.

The medusæ which are known to be, or expected to be, connected with hydroids may require a finer discrimination of specific characters than those which have direct development. The linking together of species which very closely resemble each other under a common name, but are found in localities very far apart, may lead later on to further confusion and erroneous ideas on geographical distribution of marine animals. We are not yet certain that hydroids which are universally recognised as distinct species of a genus may not have medusæ so much alike that there is the possibility of their medusæ being regarded as belonging to the same species. We know that hydroids belonging to families far removed have medusæ closely related according to our present system of classification, but we do not know what surprises are in store when all the hydroid species of *Syncoryne*, *Bougainvillia*, *Perigonimus*, *Obelia*, *Campanulina*, etc., have had their medusæ reared and traced to their adult stages.

A different treatment of specific characters appears to me to be required for those medusæ which have direct development (without any hydroid stage), especially those belonging to certain genera, such as *Liriope* and *Pelagia*, which are found throughout the warm regions of the oceans. There are many genera which have a vast geographical range, but how far their species are valid is still a debatable subject. At one time a formidable list of species was being piled up, but the tendency is now to reduce the species to about one per genus. I think this latter process is being carried too far, it makes work easy for the systematist, but is bad for Science. It appears to me that a species belonging to this class of medusæ shows a far greater range of variation than those belonging to the Anthomedusæ and Leptomedusæ. We have formerly been basing the specific characters upon a too limited number of specimens, and have described the characters of an individual rather than those of a race. There are certainly distinct races of *Liriope* and *Pelagia*, and some of them are good species.

The following is a classified list of genera and species found on the cruise of the "Sealark":

HYDROMEDUSÆ.

ANTHOMEDUSÆ.

Euphysora bigelowi, Maas.
Steenstrupia normani, n. sp.
Zanclea orientalis, n. sp.
Zanclea juv.
Cytæis tetrastyla, Eschscholtz.
Bougainvillia fulva, Agassiz and Mayer.
Turritopsis nutricula, McCrady.
Amphinema sp.
Leuckartiara gardineri, n. sp.
Pandæa juv.
Heterotiara minor, Vanhöffen.
Proboscidactyla tropica, Browne.
Proboscidactyla sp.

LEPTOMEDUSÆ.

Tiaropsis rosea, Agassiz and Mayer.
Phialidium sp.
Irene sp.
Mesonema pensile (Modeer).
Æquorea macrodactyla (Brandt).

TRACHOMEDUSÆ.

Olindias singularis, Browne.
Rhopalonema velatum, Gegenbaur.
Sminthea eurygaster, Gegenbaur.
Pantachogon rubrum, Vanhöffen.
Halicreas papillosum, Vanhöffen.
Aglaura hemistoma, Péron et Lesueur.
Amphogona apsteini (Vanhöffen).
Liriope tetraphylla (Chamisso et Eysenhardt).
Liriope sp.
Geryonia proboscidalis (Forskål).

NARCOMEDUSÆ.

Solmaris sp.
Ægina citrea, Eschscholtz.
Solmundella mediterranea (Müller).
Cunina sp.

SCYPHOMEDUSÆ.

Charybdea sp.
Nausithöe punctata, Kölliker.
Atolla wyvillei, Haeckel.
Pelagia panopyra (Péron et Lesueur).
Pelagia flaveola, Eschscholtz.
Pelagia sp.
Rhizostoma andromeda var. *maldivensis*, Browne.

Lists of Species found within definite areas during the cruise of the "Sealark."

I have not prepared lists of medusæ taken in every haul of the nets nor for every station, but have grouped together the stations under convenient geographical headings. The longest list belongs to the Chagos Archipelago, and that may be probably due to more collecting of plankton having been done within that area, than in other areas, such as at Mauritius. Professor Gardiner made serial hauls at different depths and also hauls at definite intervals of time at several of the stations. I made records of the medusæ found in every haul, but failed to obtain any reliable results owing to the scarcity of specimens.

CHAGOS ARCHIPELAGO.

Steenstrupia normani.
Zanclea orientalis.
Cytæis tetrastyla.
Bougainvillia fulva.
Turritopsis nutricula.
Pandæa juv.
Heterotiara minor.
Phialidium sp.
Mesonema pensile.
Æquorea macrodactyla.
Olindias singularis.
Rhopalonema velatum.
Sminthea eurygaster.
Pantachogon rubrum.
Aglaura hemistoma.
Amphogona apsteini.
Liriope tetraphylla.
Geryonia proboscidalis.
Solmaris sp.
Ægina citrea.
Solmundella mediterranea.
Cunina sp.
Nausithöe punctata.
Atolla wyvillei.
Pelagia panopyra.
Pelagia sp.

SAYA DE MALHA BANKS.

Cytæis tetrastyla.
Irene sp.
Æquorea macrodactyla.
Aglaura hemistoma.
Liriope tetraphylla.
Pelagia flaveola.

NAZARETH BANK (Cargados Carajos).

Euphysora bigelowi.
Irene sp.
Amphogona apsteini.
Liriope tetraphylla.

MAURITIUS.

Tiaropsis rosea.
Rhopalonema velatum.
Aglaura hemistoma.
Liriope tetraphylla.
Geryonia proboscidalis.
Cunina sp.

FARQUHAR GROUP.

Proboscidactyla sp.
Rhopalonema velatum.
Halicreas papillosum.
Aglaura hemistoma.
Liriope tetraphylla.
Solmaris sp.
Solmundella mediterranea.
Cunina sp.
Charybdea sp.

BETWEEN PROVIDENCE AND ALPHONSE ISLES

(Lat. 8° 16′ S., Long. 51° 26′ 8 E.).

Pantachogon rubrum.
Halicreas papillosum.
Liriope tetraphylla.
Atolla wyvillei.

ALPHONSE ISLAND.

Euphysora bigelowi.
Zanclea juv.
Aglaura hemistoma.
Liriope tetraphylla.
Cunina sp.

AMIRANTE GROUP.

Bougainvillia fulva.
Amphinema sp.
Leuckartiara gardineri.
Proboscidactyla tropica.
Laodice?
Phialidium sp.
Rhopalonema velatum.
Sminthea eurygaster.
Halicreas papillosum.
Aglaura hemistoma.
Liriope tetraphylla.
Solmundella mediterranea.
Nausithöe punctata.

SEYCHELLES GROUP.

Cassiopea andromeda var. *maldivensis.*

Some of the results obtained by this expedition for the geographical distribution of medusæ are rather interesting.

Turritopsis nutricula had not before been found in the Indian Ocean. It is a well-known species on the North Atlantic coast of the United States, south of Cape Cod, and it also has quite recently been recorded from Japan.

Tiaropsis rosea and *Euphysora bigelowi* have had their range extended westwards from the Malay area.

Proboscidactyla tropica is the most interesting find in the collection; it has not been recorded since Huxley first found it in Louisiade Archipelago (Malay area).

Olindias singularis occurs at Chagos, which is not so far from the Maldives, where it was first discovered. Since its discovery it has been found far away in the middle of the Pacific among the Paumotu Isles.

Sminthea eurygaster is new to the Indian Ocean; its old records are for the Mediterranean, the Bay of Biscay, and in the Atlantic as far south as Brazil.

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HYDROMEDUSÆ.

ANTHOMEDUSÆ.

Genus Euphysora, Maas, 1905.

Hartlaub (1907) and Mayer (1910) agree in uniting the genera *Euphysa* and *Euphysora* with *Corymorpha*. (Mayer uses the name *Steenstrupia* in the place of *Corymorpha*; the former is a medusoid generic name and the latter a hydroid generic name.) I am in agreement with them so far as *Euphysa* is concerned, but am not, at present, inclined to follow them in the case of *Euphysora*.

Both *Steenstrupia rubra* and *Euphysa aurata* have one fully developed perradial tentacle and three perradial marginal bulbs. The latter are called rudimentary tentacles by the above authors, but it must be clearly understood that the tentacles have completely disappeared on the three bulbs. Far remote ancestors may possibly have had four fully developed tentacles, but now only one tentacle remains, the others having their former positions marked by the bulbs.

It is known that *Steenstrupia rubra* is the medusa belonging to the hydroid *Corymorpha nutans*. Hartlaub believes that *Euphysa aurata* is probably connected with *Corymorpha nana* Alder, but at present there is no definite proof, though Mayer records the connection as a definite fact. We have no clue to the hydroids connected with *Euphysora*.

The genus *Euphysora* was established by Maas for those Codonidæ having four fully developed tentacles, but one tentacle unlike the others being larger and different in external appearance.

There are three species belonging to this genus. The first was described by Bigelow (1904, p. 251, pl. 1) from the Maldives under the name of *Euphysa tetrabrachia*, and the second by Maas from the Malay Archipelago under the name of *Euphysora bigelowi*, and this is the type species of the genus. Bigelow was doubtful about the generic position of his new species, but Maas placed it in the new genus *Euphysora* and at the same time pointed out the characters by which the two species could be recognised.

Without going into every minute detail the two species can be easily distinguished by the structure of their tentacles. *Euphysora tetrabrachia* has annular rings of nematocysts on all the tentacles, but more on the longest tentacle. *Euphysora bigelowi* has large globular clusters of nematocysts on the longest tentacle only. Mayer is inclined to regard the two species as being identical, for in his monograph (p. 37) he has written: "Future studies will probably show that these distinctions are not of specific value, but merely changes due to growth and variation, and that the two medusæ are identical and should be called *Steenstrupia tetrabrachia*."

The third species, *Euphysora valdiviæ* Vanhöffen (1911), has lateral branches on its principal tentacle. This species I shall refer again to under *Steenstrupia normani*.

1. Euphysora bigelowi, Maas, 1905.

Euphysora bigelowi, Mass, 1905, p. 7, Taf. 1, figs. 1—3.
Euphysora bigelowi, Maas, 1906, p. 84, pl. 2, figs. 1—2.
Euphysora bigelowi, Müller, 1908, p. 59.
Steenstrupia bigelowi, Mayer, 1910, vol. i, p. 36, fig. 9.
Euphysora bigelowi, Vanhöffen, 1911, p. 197.
Euphysora bigelowi, Vanhöffen, 1912, p. 7, Taf. 1, fig. 3.

Localities. Cargados Carajos, Surface. 30 Aug. 1905, i. 2 specimens. Alphonse Is., Surface (Temp. 80° F.). 7 Oct. 1905, dd.* 1 specimen.

The specimens in the "Sealark" collection belong to the species *Euphysora bigelowi*, and only a brief description of them is necessary as the species has been fully described and well figured by Maas. The smallest specimen is about 1·5 mm. in length, and has seven globular clusters of nematocysts upon the principal tentacle. The next in size is about 3 mm. in length, and the principal tentacle is also provided with seven batteries of nematocysts. Neither of these specimens shows gonads. The largest specimen is about 4 mm. in length and 2 mm. in width, and has a well-developed spermary which surrounds the stomach and extends along its whole length, just leaving the circular mouth free. Upon the principal tentacle there are eleven globular clusters of nematocysts forming a half loop round the tentacle. The three other marginal tentacles are quite different in shape and appearance. They taper to a point and have a smooth external surface, the nematocysts being scattered. In the largest specimen the tentacle opposite to the principal tentacle is much shorter than the others, but in the smaller specimens the three tentacles are about equal in size. None of the specimens show the apical prolongation of the stomach in the shape of a canal, which was present in many of the medusæ seen by Maas.

Distribution. Indian Ocean; Pacific Ocean, Malay Area.

2. Steenstrupia normani nova species.

(Plate **39**, fig. 1.)

Locality. North of Chagos, Lat. 4° 16′ S., Long. 71° 53′ E. 100—0 fms. 17 May, 1905, B. 1 specimen.

Description of the Species:—Umbrella about twice as high as broad, with a conical apex, and thin walls. Ex-umbrella with twelve longitudinal streaks of nematocysts extending from the margin to the apex, having lateral branches and forming a kind of network on the lower part of the umbrella. Stomach large, cylindrical, with a tube-like mouth extending beyond the velum, and with an endodermal cellular prolongation into the apex of the umbrella. Four thick radial canals and a very thick circular canal. One perradial tentacle, with a long, hollow, sac-like basal bulb, and terminating with a large globular ball containing nematocysts, and also three other globular clusters of nematocysts probably unilaterally arranged. Three small perradial bulbs without tentacles on the margin of the umbrella.

Size. Umbrella 1·25 mm. in width and 2·5 mm. in height.

The specimen is in very good condition, but a few more showing later stages would

* For List of stations see *Trans. Linn. Soc.* Ser. 2. Zool. xii. (1907), p. 170.

have been welcomed. The stomach is very much swollen out with food and it almost fills up the whole of the cavity of the umbrella. It is evidently a young stage as I cannot detect gonads upon the stomach, which has fairly transparent walls. The stomach occupies the whole of the top of the cavity of the umbrella and even extends above it, as the radial canals leave the stomach laterally. The radial canals and circular canal have a very cellular appearance and look as if composed of a solid chord of very large cells. The solitary tentacle has a large sac-like basal bulb with rather thin walls, covered with large flat ectoderm cells and practically free from nematocysts. The tentacle itself is contracted and coiled up. It has three lateral clusters of nematocysts projecting from the tentacle and a large globular terminal cluster. The lateral clusters are globular and vary in size; the smallest at the top and the largest at the bottom. Owing to the coiling of the tentacle their exact position on the tentacle is doubtful.

In the three perradii without tentacles there are only small bulbs projecting from the margin. They are solid in appearance, covered with nematocysts, and show no signs of developing tentacles. It is not easy to trace out completely the tracks of nematocysts upon the ex-umbrella. There are clear indications of twelve longitudinal tracks running right up to the apex of the umbrella and some of these tracks unite near the apex. The main tracks have also short lateral branches which join on to branches from adjacent tracks and form a kind of network on the lower part of the umbrella. There are no signs of any ocelli on the marginal bulbs or tentacle.

The characters selected for distinguishing the species are the shape and structure of the tentacle and the numerous tracks of nematocysts upon the ex-umbrella.

This new species is named after my friend and neighbour the Reverend Canon A. M. Norman, whose name is well known to all marine zoologists.

Euphysora valdiviæ, which Vanhöffen (1911) described as a new species from a single specimen taken near Siberut Island off the west coast of Sumatra (west of Padang), has certain characters in common with *Steenstrupia normani*. Both species have similar tracks of nematocysts upon the ex-umbrella; the same type of large stomach, and large radial and circular canals. The principal tentacle of *Euphysora valdiviæ* has lateral branches, and is evenly covered with nematocysts without any arrangement of rings or knobs. In addition to the principal tentacle there are three other smaller tentacles without branches.

As *Steenstrupia normani* is not half the size of *Euphysora valdiviæ* and is at an immature stage, one has to consider the question of *Steenstrupia normani* being an early stage of *Euphysora valdiviæ*. There is no evidence that three marginal bulbs of *Steenstrupia normani* will develop tentacles, though there is a possibility of their doing so. The principal tentacle of *Steenstrupia normani* has very conspicuous globular clusters of nematocysts. These clusters project from the tentacle, but they do not appear to be upon stalks or lateral branches. But if such stalks or lateral branches were strongly contracted, then possibly the clusters would come alongside the tentacle. Vanhöffen states that the principal tentacle of *Euphysora valdiviæ* is without knobs or rings of nematocysts and his figures do not show them. Their absence is in favour of *Steenstrupia normani* being a distinct species.

3. Zanclea orientalis nova species. (Pl. **39**, figs. 2 and 3.)

Locality. North of Chagos, Lat. 4° 16′ S., Long. 71° 53′ E. 500 fms. (Wolfenden's closing net). 18 May, 1905, G. 1 specimen.

Description of the Species:—Umbrella a little higher than broad, with a rounded summit and rather thin walls. Velum very narrow. Stomach cylindrical, about half the length of the cavity of the umbrella. Mouth circular. Gonads extending nearly the whole length of the stomach and forming interradial swellings. Two large opposite perradial tentacles armed with globular batteries of nematocysts upon contractile stalks. No tentacles in the other two opposite perradii, but only two very rudimentary internal bulbs. Four perradial patches of nematocysts upon the margin of the umbrella, without any groove or streak leading to them.

Size. Umbrella about 1·5 mm. in width and 2 mm. in height.

The character selected to distinguish this new species is the presence of rather broad perradial patches of nematocysts upon the margin of the umbrella. These patches (fig. 3) are situated directly on the margin and have no tracks or grooves leading to them. There are no longitudinal bands of nematocysts upon the ex-umbrella, but its whole surface is sprinkled with small isolated nematocysts. The tentacles are in a contracted condition and so also are the stalked batteries of nematocysts. The exterior of the battery is covered with a thin layer of ectoderm, and the nematocysts are packed away inside, practically filling the whole of the interior of the ball. The stalked batteries of nematocysts are along only the outer side of the tentacles.

The depth at which this specimen was taken is not trustworthy, as the messengers working the net were not acting properly.

4. Zanclea juv.

Locality. Alphonse Is., Surface. 7 Oct. 1905, ee. 1 specimen.

The umbrella is nearly 2·5 mm. in height and 1·75 mm. in width, with thick walls and a rounded summit. The stomach is short, about 0·5 mm. in length, and with a circular mouth. Four perradial canals. There are two opposite perradial tentacles armed along their outer side with stalked batteries of nematocysts, which are oval in shape, about twice as long as wide, and about twice the size of those in the batteries of *Zanclea orientalis*. The stalks have the appearance of rather fine filaments, studded with small isolated nematocysts. In the other two opposite perradii there is the merest trace of a marginal bulb, which has not the appearance of ever developing a tentacle. Upon the ex-umbrella there are four perradial tracks of nematocysts. They are very short, just curling over the margin and terminating with a small cluster of nematocysts.

This is evidently a young medusa, as there are no signs of gonads upon the stomach.

5. Zanclea ?.

Locality. Chagos, Peros Atoll. 75—0 fms. 30 June, 1905, M. 1 specimen.

The umbrella is thick but contracted and torn; about 2·5 mm. in width and 2 mm. in height. The stomach is badly damaged, but there are cells at its base, interradially

situated, having the appearance of ova. Two large opposite perradial basal bulbs, globular in shape, from which tentacles have been broken off. In each of the other two opposite perradii there is a minute rudimentary bulb. There are four perradial tracks of nematocysts upon the ex-umbrella, about 0·5 mm. in length. The tracks lead to an oval patch of nematocysts, situated upon a slight prominence of the ex-umbrella.

This specimen probably belongs to the genus *Zanclea*, as it has tracks of nematocysts upon the ex-umbrella, and only two tentacles.

6. Zanclea ?.

Locality. Lat. 8° 16′ S., Long. 51° 26′ E. (between Providence and Alphonse). 900—0 fms. 6 Oct. 1905, aa. 1 specimen.

The umbrella is thick, with a rounded summit, about 2·5 mm. in height and slightly less in width. The stomach at its base is cross-shaped and tapers down to a slender tube terminating with a circular mouth, which is about on a level with the margin of the umbrella. Upon the upper half of the stomach are situated four gonads, which occupy the whole of the spaces between the four perradii. There are four perradial basal bulbs all about the same size, from which tentacles have apparently been broken off. Upon the margin of the ex-umbrella there are four perradial tracks of nematocysts, one above each of the basal bulbs. They have the appearance of straight, narrow canals, less than 0·5 mm. in length.

Owing to the absence of tentacles it is impossible to be sure of the correct determination of the genus. It is probably a *Zanclea* with four tentacles.

Genus Cytæis, Eschscholtz, 1829.

There have been several species of *Cytæis* described at intervals, and located in different regions of the world. Vanhöffen, who has examined a very large number of *Cytæis* collected by different expeditions in the Atlantic, Indian and Pacific Oceans, definitely comes to a conclusion that there is only one species in this genus, and to it he assigns the oldest specific name, *Cytæis tetrastyla*, Eschscholtz.

There is, however, a feeling of doubt in my mind as to there being only one species of *Cytæis*. I am inclined to regard *Cytæis vulgaris*, Agassiz and Mayer, from the Fiji Isles as a distinct species, and also *Cytæis pusilla*, Gegenbaur, from the Mediterranean. I think that as Vanhöffen has taken as a type the somewhat vaguely defined and badly drawn *Cytæis tetrastyla* of Eschscholtz, it will be best to follow him by grouping under its name at all events the following :—

Cytæis nigritina, Haeckel, 1879, p. 74, Taf. 6, figs. 2—5.
Cytæis macrogaster, Haeckel, 1879, p. 74, Taf. 6, fig. 1.
Cytæis nigritina, Maas, 1904, p. 8, pl. 1, fig. 3.
Cytæis herdmani, Browne, 1905, p. 135, pl. 1, fig. 1.
Cytæis vulgaris, Bigelow, 1909, p. 190, pl. 6, fig. 3, pl. 40, fig. 2 and fig. 5, pl. 43, figs. 4—5.
Cytæis tetrastyla, Vanhöffen, 1911, p. 204, Text-fig. 6.
Cytæis tetrastyla, Vanhöffen, 1912, p. 8, Taf. 1, fig. 5.

The above-mentioned figures show specimens with large triangular basal bulbs extending some way up the umbrella, and the tentacles should have a pigmented endoderm.

7. Cytæis tetrastyla, Eschscholtz, 1829.

Localities. North of Chagos Archipelago, Surface (Temp. 82° F.). 18 May, 1905, D. 1 specimen. South of Saya de Malha Banks. 50—0 fms. 4 Sept. 1905, m. 2 specimens. North of Saya de Malha Banks, Surface (Temp. 77°—80° F.). 8 Sept. 1905, n. 1 specimen.

The specimens collected by the "Sealark" are not in good condition. The largest is about 2 mm. in diameter. Its stomach is on a short peduncle and the mouth surrounded with at least twelve capitate tentacles. The four perradial marginal tentacles are internally pigmented with a very dark reddish colour along their whole length, and covered with a very thick ectoderm. The specimens have a few medusa-buds upon the stomach. The structure of the tentacles and the shape of the basal bulbs are similar to those of *Cytæis herdmani*.

Some of the specimens reported upon by Vanhöffen were collected by the "Valdivia" in the Indian Ocean, one station being north of Chagos.

8. Bougainvillia fulva, Agassiz and Mayer, 1899.

Bougainvillia fulva, Agassiz and Mayer, 1899, p. 162, pl. 2, fig. 6; 1902, p. 145, pl. 2, fig. 8.
Bougainvillia fulva, Maas, 1905, p. 10, Taf. 1, fig. 8, Taf. 2, figs. 9—10; 1906, p. 87, pl. 2, figs. 4—5.
Bougainvillia fulva, Bigelow, 1909, p. 195, pl. 6, fig. 7, pl. 44, figs. 5—7.
Bougainvillia fulva, Hartlaub, 1909, p. 448, Taf. 19, figs. 1—4.
Bougainvillia fulva, Mayer, 1910, p. 160.

Localities. Chagos Archipelago, Salomon Atoll. 180—0 fms. 30 June, 1905, O. 11 specimens. Amirante Isles, Desroches Atoll. 400—0 fms. 16 Oct. 1905, mm. 1 specimen.

Except for the contraction of the margin of the umbrella the specimens are in very good condition. The smallest one measured 6 mm. in height and 4 mm. in width, and the largest 13 mm. in height and 10 mm. in width.

The umbrella is very thick, about as thick at the top as on the side. Its natural shape is altered owing to the great contraction of the margin. The contraction produces deep perradial furrows and interradial ridges or lobes which meet in the centre of the umbrella opening and close it up completely. The specimen figured by Maas (1906, pl. 2, fig. 5) resembles this very closely in the shape of the contracted umbrella, but the jelly above the sub-umbrella cavity is thicker than in my specimens.

The stomach varies considerably in shape. When empty and uncontracted it hangs down as a thin cruciform sac, but when full of food it becomes nearly globular. The four oral tentacles are dichotomously branched, four times in the smallest specimen and seven times in the largest one. The gonads form swellings upon the wall of the stomach and have the appearance of eight distinct sacs, isolated perradially and interradially.

The marginal tentacles are more or less contracted, and are very small and slender when compared with the size of the umbrella. In the smallest specimen there are twelve tentacles on each compound bulb; and fourteen on a bulb was the maximum number counted in the largest specimen. An ocellus is situated on the inner side of every

tentacle, very close to the bulb; it is a narrow band of dark pigment on the surface of the ectoderm.

One specimen is infested with *Cunina* buds in different stages of development. The buds are attached to the sub-umbrella close to the base of the stomach. The largest *Cunina* shows three rows of otoporpæ on each lappet, and is about ready for liberation.

Bougainvillia fulva is widely distributed over the Pacific and Indian Oceans, and lives within the tropical belt.

Genus Turritopsis, McCrady, 1857.

There are differences of opinion amongst specialists on medusæ as to the number of species that should be recognised as belonging to the genus *Turritopsis*. Mayer (1910) and Bigelow (1913) clearly consider that the American *Turritopsis nutricula*, McCrady, is identical with the European *Turritopsis polycirrha*, Keferstein. Maas (1909) is practically of the same opinion, but he suggests that the species should be kept apart, as local forms or varieties. Acting upon his own suggestion, Maas described a new *Turritopsis* from Japan as a new variety of *Turritopsis nutricula*.

Hartlaub (1911) on the other hand seems fairly convinced that the American and European *Turritopsis* belong to distinct species. I may here say that I agree with Hartlaub in placing *Turris neglecta*, Lesson, as a synonym of *Turritopsis polycirrha*. Sometime before the appearance of Dr Hartlaub's publication I had already come to the same conclusion.

With regard to the medusa described by Maas (1909) under the name of *Turritopsis nutricula*, var. *pacifica* from Japan, I think it should be regarded as a distinct species, and under the name *Turritopsis pacifica*. Maas clearly states that the ocelli are abaxial, that is to say, on the outer side (ex-umbrella side) of the basal bulbs, whereas both *Turritopsis nutricula* and *Turritopsis polycirrha* have their ocelli on the inner side of the basal bulbs. Even if Maas, as Bigelow (1913) has hinted, has accidentally recorded and figured the ocelli on the wrong side of the bulb, still, in my opinion, it remains a distinct species. Maas's figures show that the formation of endoderm above the stomach is similar to that of *Turritopsis polycirrha*, but it can be distinguished from *Turritopsis polycirrha* by having a much larger number of tentacles (120—150) arranged in several rows round the margin of the umbrella.

Since I have seen the specimens of *Turritopsis* in the "Sealark" collection and compared them with specimens of *Turritopsis polycirrha* from the English Channel and the North Sea, I am strongly in favour of Hartlaub's views and believe the reasons given by him for separating the American and European species are sound.

In *Turritopsis nutricula* the radial canals, by a considerable thickening of their walls, and coalescence, form a kind of endodermal peduncle upon which the stomach hangs.

In *Turritopsis polycirrha* a further development of endoderm takes place. It is no longer confined to the walls of the radial canals, but grows across the top of the umbrella cavity and forms a homogeneous mass of cells. This extension also grows downwards and takes in the radial canals in the uppermost part of the sub-umbrella. The extension

of the endoderm is recorded by the leaving of the outer half of the radial canal wall in situ alongside the umbrella. In adult specimens the radial canals run alongside this mass of endoderm nearly to the top of the sub-umbrella and there they curve sharply inwards to the stomach.

Turritopsis nutricula has been well described and figured by American naturalists, and there is no evidence to show that its endodermal peduncle is converted by further development into a mass of cells which block up the upper part of the cavity of the sub-umbrella. Maas (1909) has already said that the differences between the two species may be defined as stages in development, and that is the case, but up to the present I have failed to find any proof that *Turritopsis nutricula* develops into *Turritopsis polycirrha*.

9. Turritopsis nutricula, McCrady, 1857.

Oceania (*Turritopsis*) *nutricula*, McCrady, 1857, p. 55, pl. 4.
Turritopsis nutricula, McCrady, 1858, p. 127, pl. 8, fig. 1.
Modeeria multitentacula, Fewkes, 1881, p. 149, pl. 3, figs. 7—9.
Turritopsis nutricula, Brooks, 1886, p. 388, pl. 37.
Turritopsis nutricula, Brooks and Rittenhouse, 1907, pp. 429—460, pls. 30—35.
Turritopsis nutricula, Mayer, 1910, p. 143, pl. 14, figs. 10—13, pl. 15, figs. 10—13.
Turritopsis nutricula, Bigelow, 1913, p. 8.

Locality. Chagos Archipelago, Salomon Atoll, Surface. 5 July, 1905, Q. 2 specimens.

The umbrella is about as high as broad (2·5 mm.), with a rounded summit; its sides are slightly curved inwards about the middle and the walls are rather thin. Velum moderately broad. The stomach is large and cross-shaped. The mouth has four very short perradial lips and its whole margin is lined with isolated, globular, clusters of nematocysts. Four fairly broad radial canals. The radial canals on leaving the stomach proper are very wide and have very thick walls, which coalesce, so that the stomach appears to hang from a thick cellular peduncle, about one-third its length. The gonads are interradial upon the walls of the stomach; one specimen has ova and the other spermatozoa. The tentacles are arranged in a single row on the margin of the umbrella (one specimen with 56, the other with 45 tentacles). They have a smooth, even surface, but are densely covered with minute nematocysts, and terminate with a bulbous enlargement. The basal bulbs of the tentacles vary in size, especially in length. They adhere on the outer side to the margin of the umbrella, and the basal half of the inner side is covered with a semicircular loop of nematocysts. There is a small reddish-looking ocellus on the inner side of every bulb, situated close to the tentacle.

The specimens in the "Sealark" collection are similar to the published figures of *Turritopsis nutricula*. The formation of the endodermal peduncle is identical with that of *Turritopsis nutricula*, and not at all like that of *Turritopsis polycirrha*.

Bigelow (1913) in his description of *Turritopsis nutricula* from Japan calls attention to a distinct terminal dilatation of the tentacles, and he points out that similar dilatations also occur in specimens taken on the American coast at Newport. It is strange that these dilatations have not been previously noticed by the American naturalists. The specimens

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in the "Sealark" collection also show a large hollow enlargement of the distal end of some of the tentacles. I am rather inclined to regard these dilatations in some way due to the action of the killing re-agents used. I can find no such dilatations in *Turritopsis polycirrha*; their tentacles in a semi-contracted condition are rather club-shaped, as shown in the figure of *Turritopsis nutricula* by Mayer (1910, pl. **14**, fig. 13).

The hydroid of *Turritopsis nutricula* is known under the name of *Dendroclava*, which is probably identical with *Tubiclava* of Allman.

The medusoid genus has been previously recorded from the Indian Ocean. Vanhöffen (1911) found a damaged specimen of *Turritopsis* between the Chagos Islands and the Seychelles. Bigelow (1904) found a young *Turritopsis* in Felidu Atoll, Maldives.

Distribution. North Atlantic along the coast of United States. Pacific Ocean, Japan.

10. Amphinema sp. ?

Locality. Amirante Islands, Desroches Atoll. 200—0 fms. 16 Oct. 1905, kk. 1 specimen.

This little medusa was preserved in alcohol and is in rather a fragile condition.

The umbrella is thin, a little less than 2 mm. in length and width, with apparently a small apical projection. The stomach is not situated upon a peduncle. The mouth has four small lips. The whole manubrium projects about half its length beyond the margin of the umbrella. There are four inconspicuous radial canals, which apparently leave the stomach a little way down its sides, and slight traces of very small inconspicuous mesenteries, but as it is difficult to estimate the amount of contraction and shrinkage the presence of mesenteries remains doubtful. The gonads form eight adradial folded bands along the upper half of the manubrium, and each contains a few fairly large ova.

There are two large, opposite, perradial tentacles, with large tapering basal bulbs, slightly laterally compressed. The basal bulbs are very opaque and of a dark brownish colour; but probably of quite a different colour when alive. On each half of the margin of the umbrella, between the two tentacles, there are five very small bulbs, little longer than broad, and evidently do not develop large tentacles. No trace of an ocellus could be seen on any of the bulbs.

This is an adult medusa probably belonging to a *Perigonimus*-like hydroid. I cannot determine the species with any degree of certainty, as it does not show clearly any well-marked character. A few more specimens were wanted, and in better condition.

Genus Leuckartiara, novum nomen, Hartlaub, 1914. (Tiara, preoccupied name.)

11. Leuckartiara gardineri, nova species (Pl. **39**, fig. 4).

Locality. Amirante Islands, Surface. 10 Oct. 1905, gg. 1 specimen.

Description of the Species:—Umbrella conical, about twice as high as broad, with rather thin walls. Four very conspicuous perradial canal-like bands projecting from the surface of the ex-umbrella, and extending from the tentacles nearly to the summit of

the umbrella. Stomach large, occupying more than half the cavity of the umbrella. Mouth large, and its margin in folds. Four fairly broad perradial canals, without any lateral processes, and with a slit-like union with the stomach along its whole length; thus forming the so-called "mesenteries" which attach the stomach perradially to the wall of the sub-umbrella. Four gonads, isolated perradially, and arranged in eight adradial bands, which are composed of bifurcated transverse folds and united interradially by a transverse fold. Four long perradial tentacles, with laterally compressed basal bulbs clasping the margin of the umbrella. Also very minute interradial and adradial tentacles, and a few marginal bulbs without tentacles. A blackish ocellus on the outer side of all basal bulbs of the minute tentacles and marginal bulbs.

Size. Umbrella about 3·5 mm. in width and 6 mm. in height.

The collection contains only one specimen, and it is in a splendid state of preservation, but with the margin contracted inwards.

This new species, which I have great pleasure in naming after the leader of the "Sealark" expedition, has a character well-marked by the presence of four perradial canal-like bands upon the ex-umbrella. These bands are probably brightly coloured in the sea. They extend beyond the margin on to the outer edge of the basal bulbs of the large tentacles and contain nematocysts. Although ocelli are clearly visible on the basal bulbs of the minute tentacles, still they cannot be seen upon the basal bulbs of the large perradial tentacles. I am inclined to take the view that this species has not more than four large tentacles and that the minute tentacles remain in a rudimentary condition. The gonads show ova fairly well advanced, so that the specimen is not an early stage.

12. Pandæa juv.

Locality. Chagos Archipelago, Salomon Atoll. 10—0 fms. 1 July, 1905, P. 1 specimen. Surface. 5 July, 1905, Q. 2 specimens.

The specimens are young stages in a contracted and crumpled condition. The smallest is about 2·5 mm. in diameter, its umbrella has conspicuous longitudinal ridges carrying nematocysts. There is a nematocyst track corresponding to every tentacle and bulb. The perradial ridges extend to the summit of the umbrella and the other ridges or tracks are shorter, their length and size being correlated with the age of the tentacle. The development of the gonads is just commencing and their position is marked by small isolated pits in the wall of the stomach. There are seven tentacles and a few adradial bulbs, the latter are at different stages of growth. A conspicuous black ocellus is situated on the outer side of all the basal bulbs of the tentacles and on some of the larger adradial bulbs.

The second specimen is a little older and about twice the size of the smallest specimen. In this specimen the stomach has flattened out and the mouth expanded to its extreme limit. The four perradial canals leave the stomach close to the four corners of the mouth. There are nine tentacles and seven tentacular bulbs, each one having a black ocellus.

The third specimen closely resembles the last one. It shows very clearly that the adradial tentacles do not all begin to develop at the same time.

These early stages are either identical with or closely related to *Pandæa conica* (Quoy et Gaimard) which is a common species in the Mediterranean. Vanhöffen (1911) records the occurrence of *Tiara* (*Pandæa*) *conica*, Lesson, in the Agulhas Current, Indian Ocean.

Genus Heterotiara, Maas, 1905.

There are two species belonging to the genus *Heterotiara*, namely *Heterotiara anonyma*, Maas (1905) and *Heterotiara minor*, Vanhöffen (1911). A complete description of *Heterotiara anonyma* could not be given by Maas as the specimens had lost their tentacles. Vanhöffen on the cruise of the "Valdivia" obtained *Heterotiara anonyma* as well as *Heterotiara minor*, and again *Heterotiara anonyma* was taken without tentacles.

Bigelow (1909) found, in the material collected by the "Albatross" in the Humboldt Current off Peru, two specimens of a medusa which he has fully described and figured under the name of *Heterotiara anonyma*. These specimens have their tentacles tapering to a point, and therefore are not like those of *Heterotiara minor* terminating with a bulb.

Bigelow (1913) also records *Heterotiara anonyma* from the Bering Sea, where the "Albatross" obtained many specimens. Their tentacles, however, terminate in a spherical knob much the same as in *Heterotiara minor*. On the same cruise *Heterotiara minor* was plentifully found at the Philippines, but the specimens have not yet been fully described. Bigelow states that *Heterotiara minor* and *Heterotiara anonyma* are undoubtedly distinct, "They are separated by the number of tentacles correlated with size, *H. anonyma* having twelve tentacles (or less) when adult, and reaching a height of 20 mm., whereas *H. minor* has about twice as many tentacles, though much smaller (only about 10 mm. high)."

Bigelow has described and figured *Heterotiara anonyma* from off the coast of Peru with tentacles tapering to a point, and from the Bering Sea with tentacles terminating in a bulb, as in *Heterotiara minor*. It seems to me that either the Peruvian specimens have been inaccurately described or that they belong to another genus, and I am inclined to take the latter view.

13. Heterotiara minor, Vanhöffen, 1911.

Heterotiara minor, Vanhöffen, 1911, p. 212, Taf. 22, fig. 5, Text-fig. 8.
Heterotiara minor, Bigelow, 1913, p. 25.

Locality. Lat. 4° 16′ S., Long. 71° 53′ E. (North of Chagos). 1200—0 fms. 17 May, 1905, C. 1 specimen.

This single specimen is in fairly good condition. Its umbrella measures 13 mm. in height and 12 mm. in width. The stomach is contracted into folds and hangs free inside the cavity of the umbrella. There are four radial canals and no centripetal canals. The tentacles are transparent, hollow, and terminate with a large hollow bulb, thickly covered with nematocysts. There are nineteen tentacles, varying slightly in size, the differences being due to age. The tentacles have no definite basal bulbs, but their basal portion is partly embedded in the jelly and situated in grooves on the margin of the umbrella. The specimen resembles Vanhöffen's text-figure 8.

14. Proboscidactyla tropica, Browne, 1904.

Willsia sp. Huxley, 1877, p. 120, fig. 17.
Proboscidactyla tropica, Browne, 1904, p. 727.

Locality. Amirante Isles, Desroches Atoll. 100—0 fms. 16 Oct. 1905, kk. 1 specimen.

Huxley, when off the Louisiade Archipelago in 1849, found a medusa which he briefly described and figured under the name of *Willsia*. In my revision of the Williadæ (1904) I recognised this medusa as a distinct species and called it *Proboscidactyla tropica*.

Bigelow (1909, p. 220) considers *Proboscidactyla tropica* to be identical with *Proboscidactyla ornata* McCrady, 1857, var. *stolonifera*, Maas, 1905.

One of the characters, which I made use of to distinguish *Proboscidactyla tropica* from all the other species of the genus, was the form of a blastostyle bearing a cluster of nematocysts at its free end, and upon the sides of this blastostyle the medusa-buds develop. This blastostyle is similar in structure to the blastostyle of the hydroid *Lar sabellarum*, upon which medusa-buds develop, which when set free belong to the medusoid genus *Willia*.

Maas (1905) in his description of the variety *stolonifera* from the Malaysian region makes no mention of this peculiar blastostyle, and if it had been present in his specimens he could not have failed to have noticed it.

Bigelow (1909, p. 219) states that *Proboscidactyla gemmifera* (Fewkes) is only the budding form of *Proboscidactyla ornata*, McCrady, 1858. I cannot very well link *Proboscidactyla tropica* to *Proboscidactyla ornata* by means of *Proboscidactyla gemmifera*, as Brooks (1880) states clearly that the stolons have branches and each branch terminates with a medusa-bud. There is here also no mention made of any blastostyle-like stolon with a terminal cluster of nematocysts. Mayer's figures (1910, Pl. **21**) confirms Brooks's statement. Under these circumstances I prefer to retain *Proboscidactyla tropica* as a distinct species until at least we know more about the life-histories of the other species of the genus.

The specimen in the "Sealark" collection is about 2 mm. in diameter, and has lost its natural shape owing to contraction. The velum is very narrow. The stomach has four perradial lobes, from which the four main radial canals leave to join the tentacles. As in other species of the genus there is no circular canal. Each main radial canal has the appearance of being twice dichotomously branched, each terminal branch going to a tentacle. At the juncture of the first branch of each canal is situated a blastostyle-like stolon. This blastostyle has rather the appearance of a tentacle, for at its free end there is a large cluster of nematocysts. The medusa-buds are at different stages of development. Two to four on each stolon, and the largest is nearly ready for liberation. They are arranged round the sides of the stolon. Huxley, however, states that the buds are unilateral. He saw them alive, whereas I have only a contracted specimen. In one of the perradii at the junction of the second branch there is a second blastostyle-like stolon with a small bud developing. So apparently the medusa has stolons on the junction of the second branch as well as on the first.

There are sixteen tentacles, rather thick, in a contracted condition, with a thick semicircular band of nematocysts on the inner side of the basal bulbs, which project into

the substance of the umbrella. Between every two tentacles are isolated clusters of nematocysts, which extend over the ex-umbrella from the margin up to the summit, and these clusters are similar to those described in the other species of the genus. Though the specimen is in fairly good condition, it is not suitable, owing to contraction, for the making of a good drawing.

15. Proboscidactyla sp.

Locality. Farquhar Group, Providence Is., Surface. 3 Oct. 1905, x. 1 specimen.

Umbrella about 1·25 mm. in diameter. Five main radial canals, each with a lateral branch. Ten tentacles. No medusa-beds.

The specimen is not in very good condition. The number of radial canals shows that it is abnormal, and as each canal has only one branch it is evidently a young stage.

16. Anthomedusa, Genus ?.

Locality. Mauritius. 300—0 fms. 22 Aug. 1905, C. 1 specimen.

The umbrella is in a contracted condition, about 5 mm. in width and probably when alive about the same in height, rather thick. It has on its exterior surface four conspicuous, prominently projecting, perradial ridges, which extend from the margin to, or nearly to, the top of the umbrella. These ridges have rather a blunt rounded edge, with what appears to be a narrow shallow groove running along the middle of the edge. From the shape and general appearance I do not think that these ridges were formed artificially either by preservation or by contraction, but existed in the living specimen. I am not so sure, however, about the groove along the middle of the ridge, it might be due to shrinkage. I cannot recall seeing a figure of any Anthomedusa with ridges, such as appear in this specimen. The velum is very narrow, and the sub-umbrella is well covered with a layer of fine muscles. The stomach is rather contracted, and has a plain circular mouth. In its contracted condition it is rather broad, and sac-shaped. It is not likely to extend beyond the margin of the umbrella even when fully stretched out. There are four conspicuous radial canals. The wall of the stomach has the appearance of being covered with male gonads, and if so, then the gonads are at an early stage as there is no definite swelling.

The medusa has only two opposite perradial tentacles, both of which are unfortunately broken off at the basal bulbs and leaving not the slightest clue as to their structure. The basal bulbs are rather large and globular, and are attached to the margin of the umbrella, but do not project into the substance of the umbrella. The other two opposite perradii are naturally without any tentacles and also without any rudimentary bulbs, and the whole margin is also without minute rudimentary bulbs. There is apparently a patch of nematocysts on the margin of the umbrella in each of the four perradii, and there is also evidence of a short extension of them along the ridges of the ex-umbrella. No ocelli could be found.

With the complete loss of the tentacles it is impossible to determine the genus. It has certainly only two opposite tentacles, so it may be a *Dicodonium*, a *Zanclea*, or even a new genus.

LEPTOMEDUSÆ.

17. Laodice ?.

Locality. Amirante Isles, Surface. 9 Oct. 1905, gg. 1 specimen.

This specimen is probably a young *Laodice*, but the absence of gonads, which have not yet begun to develop, makes the determination of the genus uncertain. The umbrella is saucer-shaped, about 4 mm. in diameter, and moderately thick. The tentacles, not exceeding sixty in number, are very slender and short, with small basal bulbs partly extending over the margin of the umbrella and without a well-defined spur. There are a few marginal bulbs, from some of which tentacles have been broken off. Between every two tentacles or bulbs there is generally a single cordylus. Cirri are also present, but not many remain. A conspicuous black globular ocellus is situated on the inner side of most of the basal bulbs of the tentacles and marginal bulbs.

18. Tiaropsis rosea, Agassiz and Mayer, 1899.

Tiaropsis rosea, Maas, 1905, p. 30, Taf. 7, figs. 45—47.
Tiaropsis rosea, Mayer, 1910, p. 260.

Locality. Mauritius. 125—0 fms. 22 Aug. 1905, a. 1 specimen.

Description of the specimen :—Umbrella, about 3 mm. in diameter, moderately thick, and hemispherical. Velum broad. Stomach cross-shaped. Four radial canals. Gonads upon the radial canals, forming globular sacs near the stomach. Four large perradial tentacles, with pigmented basal bulbs. Seven marginal bulbs between every two tentacles. Eight adradial sensory vesicles, with a large black roundish ocellus, situated at the base of the vesicle and on the inner side.

This specimen, though much smaller in size, agrees very closely with a *Tiaropsis* described by Maas from Damar, Malay Archipelago. Maas' description and figures are based upon a single adult specimen about 15 mm. in diameter, and he considers it to be the adult stage of *Tiaropsis rosea* of Agassiz and Mayer. It has yet to be definitely proved that *Tiaropsis rosea* of Agassiz and Mayer found in Suva Harbour, Fiji, is an early stage of *Tiaropsis rosea*, Maas.

The arrangement of the marginal bulbs may help to determine this species. There are seven in each quadrant, situated as follows :—three in the interradial portion, and two on the perradial side of the two sense organs. The gonads do not extend along the radial canals as figured by Maas, but the specimen has the appearance of being immature and has probably not reached its maximum growth.

Phialidium sp. ?

There are apparently two species of *Phialidium* in the collection, but the specimens are not in a condition suitable for the determination of species.

19. Phialidium sp. A.

Locality. North of Chagos, Lat: 4° 16′ S., Long. 71° 53′ E., Surface (Temp. 86° F.). 17 May, 1905, B. 5 specimens.

Umbrella hemispherical, 3—5 mm. in diameter. Stomach quadrangular, on a slight

thickening of the sub-umbrella. Mouth with four lips. Gonads close to the margin of the umbrella and extending over about one-quarter the length of the radial canals. Tentacles, 14—16, with globular basal bulbs. One or two sensory vesicles between every two tentacles, very minute and probably have contained only one otolith.

20. Phialidium sp. B.

Locality. Amirante Isles, Surface (Temp. 79° F.). 9 Oct. 1905, gg. 6 specimens. Surface. 17 Oct. 1905, oo. 3 specimens.

Umbrella hemispherical, 5—6 mm. in diameter. Gonads close to the margin of the umbrella, linear or oval sacs extending over about one-quarter the length of the radial canals. Tentacles, 30—40, with globular basal bulbs. One to three sensory vesicles between every two tentacles.

21. Irene sp. ? A.

Locality. Nazareth Bank, Cargados Carajos, Surface. 30 Aug. 1905, g. 1 specimen.

This is an early stage without gonads. The umbrella is about 6 mm. in diameter and very thin. The stomach is small and upon a short peduncle. There are eight tentacles, with globular basal bulbs, and three to four marginal bulbs between every two tentacles. All the bulbs have a pair of cirri adjacent to them, and excretory pores are visible. A few sense organs were found, and there is probably one between every two marginal bulbs and tentacles.

22. Irene sp. ? B.

Locality. Saya de Malha Banks. 58—0 fms. 6 Sept. 1905, C, 14. 11 specimens.

These specimens are all in bad condition, so that only a general description can be given just to indicate that the Irene-like medusa occurs in that district. Their umbrellas measured 30 to 40 mm. in diameter and are moderately thick. From the centre of the umbrella hangs down a broad thick peduncle, about 20 mm. in length. Upon it a broad stomach is situated, and its mouth has four lips with the margin closely folded. It is a large mouth even in a contracted condition. There are four radial canals. The gonads, some containing well-developed ova, form laminar bands along the canals upon the sub-umbrella, but they do not extend down the peduncle. Some of the specimens have the above-mentioned organs in fairly good condition, but all have the margin of the umbrella, either completely denuded of its appendages or in such a fragmentary condition that not even one quadrant is complete. I consider there should have been fifty or more tentacles, about three marginal bulbs between every two tentacles, and at least one small sensory vesicle between every two bulbs. Excretory pores are visible in connection with the basal bulbs of the tentacles and the marginal bulbs. I can find no definite indication of marginal cirri. The margin is not only broken but has rather a macerated appearance, therefore it is not advisable to describe it in detail or base drawings upon it.

23. Mesonema pensile (Modeer) 1791.

Mesonema pensile, Browne, 1904, p. 733, pl. 55, fig. 4, pl. 57, figs. 2—9.
Mesonema pensile, Browne, 1905, p. 147, pl. 2, figs. 11—15.
Mesonema pensile, Maas, 1905, p. 42, Taf. 8, fig. 52.
Mesonema pensile, Maas, 1909, p. 26.

Locality. Chagos Archipelago, Diego Garcia. 10—14 fms. 10 July, 1905. 1 specimen.

The genus *Mesonema* of Eschscholtz has undergone several changes in its definition. In 1904 I defined it as follows:—"Æquoridæ with numerous, simple, unbranched radial canals. Stomach circular, with lower wall quite rudimentary. Mouth nearly as large as the diameter of the stomach and cannot be closed." The type species of the genus is *Mesonema pensile* (Modeer) 1791, and specimens similar to the type were described and figured by me in 1904. Both Mayer (1910) and Bigelow (1909) have raised objections to my distinguishing marks of the genus, and by which I separated it from *Æquorea*. They rightly say that owing to the great contractibility of the lower wall of the stomach it is difficult to assign to the correct genus certain species of the Æquoridæ, and therefore they consider it is advisable to recognise *Æquorea* only, and place Mesonema in its list of synonyms. I clearly foresaw this difficulty, but had hopes that further researches on the Æquoridæ might lead to the permanent retention of *Mesonema* by adding other characters so as to definitely separate it from *Æquorea*.

Vanhöffen (1911) also rejects my definition of *Mesonema* and brings forward a new definition as follows:—

Mesonema. Leptomedusæ with numerous radial canals, and with large tentacles considerably less in number than the canals. Tentacles with triangular and especially heart-shaped bulbs.

Æquorea. Leptomedusæ with numerous radial canals, with fully developed tentacles about as many or more than radial canals. Tentacles with conical basal bulbs.

Vanhöffen's characters for separating the two genera may be an improvement on mine. It is quite easy to isolate the extremes as separating characters, whether one uses the size of the mouth, the number of canals in relation to the number of tentacles, or the shape of the basal bulbs, but the difficulty is to assign to the right genus those specimens which come near the border line. We have a very imperfect knowledge of the species belonging to the genus *Æquorea*, using the term in its widest sense. Some of the species exist on paper only, as their descriptions are too vague for any further use, a few have been fully described and figured, and many disputed as to their validity by systematists.

Vanhöffen (1911) considers that *Æquorea macrodactyla*, Brandt, *Æquorea maldivensis*, Browne, and *Æquorea parva*, Browne, are all identical with *Mesonema cœlum pensile* of Modeer. It is still, however, my firm opinion that *Æquorea macrodactyla* and *Mesonema pensile* are quite distinct species. Although the original descriptions of these two old species are rather vague and their figures more like rough sketches, still their names are now associated with medusæ which have been described and figured according

to modern requirements. At present, I have no valid reasons for ranking *Æquorea parva* as a synonym.

It appears to me, in spite of the descriptions and figures given by Maas and myself of *Mesonema pensile* and *Æquorea macrodactyla*, that Vanhöffen has failed to see clearly the difference between the two species. In his sketch (1911, p. 223, text-fig. 21) of the margin of umbrella showing the basal portion of the tentacles of *Mesonema pensile*, they appear to be very much like the basal bulbs of *Æquorea macrodactyla*; they are not at all like the basal bulbs of a genuine *Mesonema pensile*.

In the "Sealark" collection there is only one specimen, which is in very bad condition. By the shape of the basal bulbs I think it is *Mesonema pensile*. The umbrella is about 15 mm. in diameter. There are eight tentacles. The radial canal system is practically destroyed, just a few canals left.

Distribution. Tropical Pacific and Indian Oceans. Maas (1909) records it from Sagami Bay (35° N., 139° 37′ E.), Japan.

24. ÆQUOREA MACRODACTYLA (Brandt) 1834.

Æquorea maldivensis, Browne, 1904, p. 732, pl. 56, figs. 4—12.
Mesonema macrodactylum, Maas, 1905, p. 40, Taf. 8, figs. 51 and 54.
Æquorea macrodactyla, Bigelow, 1909, p. 37, pl. 36, figs. 5—10.

Localities. North of Chagos. 1200—0 fms. 17 May, 1905, C. 1 specimen. Chagos Archipelago, Salomon Atoll. 180—0 fms. 30 June, 1905, O. 1 specimen. Saga de Malha. 55—0 fms. 6 Sept. 1905, C. 14. 8 specimens.

Æquorea macrodactyla of Brandt received a description according to modern requirements by Maas in 1905, and more recently Bigelow has published an account of some specimens taken in the Eastern Tropical Pacific. As the two best specimens in the "Sealark" collection agree very well with the descriptions given by Maas and Bigelow, I have no doubt that we have all seen the same species.

In one of my earlier publications on Medusæ I pointed out that the shape of the basal bulbs of the tentacles was a useful aid in the determination of the species belonging to the Æquoridæ. There are distinct types of basal bulbs, and for each type an allowance must be made for variation and also for contraction or distortion due to preservation. *Æquorea macrodactyla* has the basal bulbs curling over or clasping a thickening of the margin of the umbrella, and the character is clearly seen when a tentacle is cut out from the umbrella and viewed sideways.

Maas, when he re-described *Æquorea macrodactyla*, pointed out that its basal bulbs belonged to the same type as that found in *Æquorea maldivensis*, which had then not long been described by me as a new species. Bigelow, however, has gone a step further and considers *Æquorea maldivensis* to be the same species as *Æquorea macrodactyla*. It would now be very hard for me to keep the two species apart except by hair-splitting differences which, as far as possible, should be avoided.

The basal bulbs of the "Sealark" specimens are more like those figured by Maas and Bigelow for *Æquorea macrodactyla* than those figured by me for *Æquorea maldivensis*, but the type is the same and the differences would come within the range of variation.

The oral lips are similar in shape and structure as those figured for *Æquorea maldivensis*, but are more numerous. I am not sure that it would be advisable to take the number into consideration for one of the specific characters. Maas found the oral lips to be less than half as numerous as the radial canals. Bigelow does not mention them in his text, but a figure indicates fewer lips than canals. One of the "Sealark" specimens has about the same number of lips as radial canals.

All the specimens from the Saya de Malha Banks are in bad condition, and it is only just possible to determine the species in one specimen which has a few tentacles left. Their stomachs measured from 23—34 mm. in diameter, and radial canals numbered 72 to 100.

A few notes can be given on the specimens from the other stations.

A. The umbrella measures 42 mm. in diameter and is moderately thick. The stomach measured 27 mm. and the mouth 23 mm. in diameter. Even allowing for the lower wall of the stomach being considerably contracted, I doubt very much if it could expand sufficiently so as to allow the mouth to close up. There are 92 radial canals, a few have developed much later than the rest and bear no gonads. Seventeen large tentacles and seven much smaller in size at different stages of development. There are between every two tentacles 5—10 marginal bulbs with excretory pores. This specimen shows in a marked manner the radial muscle bands extending from the proximal end of the radial canals, across the lower wall of the stomach, to the oral lips. There is a muscle band in connection with every radial canal.

B. The umbrella is shaped like a biconvex lens and measures 45 mm. in diameter. The stomach is about 30 mm. and the mouth about 20 mm. in diameter. Around the margin of the mouth are numerous lips, about as many radial canals, and of the latter there are seventy-nine. The gonads show ova and extend as laminar bands along nearly the whole length of the canals. There are 16 large tentacles and four smaller in size. Between every two tentacles are situated 8 to 10 marginal bulbs, the central one is usually larger than the other and shows signs of developing a tentacle. The sense organs are very numerous, usually 2 to 5 between every two bulbs.

The excretory pores in both these specimens are very conspicuous on the inner side of the circular canal. They stand out like papillæ. There is one corresponding to and opposite every tentacle and large marginal bulb.

Distribution. Indian Ocean and Tropical Pacific.

25. Leptomedusa, No. 1.

Localities. North of Chagos. 75—0 fms. 16 May, 1905, A. 1 specimen. Farquhar Group, Providence Is., Surface. 5 Oct. 1905, y. 1 specimen.

The specimens are young stages, without gonads, and they probably have not yet developed their generic characters. At all events, I cannot assign them to a definite genus. Mayer (1910) gives figures (Pl. **25**, fig. 8, and Pl. **27**, fig. 1) of early stages of a *Dipleurosoma* which somewhat resembles these specimens.

Description :—The umbrella is thick, not quite so high as broad, about 4 mm. in diameter, without any apical projection. Velum narrow. The stomach is cross-shaped

when contracted, and quadrangular when expanded. It is fairly large and occupies the greater part of the top of the cavity of the umbrella. The mouth is fairly large, and has four lips. There are four radial canals, without any branching. Eight tentacles (4 perradial and 4 interradial) with thick conical basal bulbs. Between every two tentacles there are three marginal bulbs, very small and short, a little longer than broad, and from their general appearance they evidently do not develop tentacles. A conspicuous roundish dark brownish ocellus is situated on the outer side of all the basal bulbs and on all the small marginal bulbs. No trace of any cordyli, cirri, or marginal sensory vesicles could be seen. One of the specimens is a little smaller and younger than the other. It has only two marginal bulbs between every two tentacles, and one of its interradial tentacles is missing. Both specimens are badly contracted, but in a fairly good state of preservation.

26. Leptomedusa, No. 2.

Localities. Farquhar Group, Surface. 2 Oct. 1905, w. 1 specimen. Amirante Isles, Desroches Atoll. 50—0 fms., 200—0 fms. 16 Oct. 1905, kk. 2 specimens.

Description :—Umbrella hemispherical, fairly thick, 5—8 mm. in diameter. Stomach small, quadrangular when expanded. Mouth with four large lips having a crenate margin. Four narrow radial canals. Gonads extending over the outer half of the radial canals. Tentacles 16 (perhaps more), small, with small globular basal bulbs. Three to seven (usually five) elongated marginal bulbs (?) between every two tentacles. Two sensory organs between every two tentacles.

I cannot determine the genus to which these specimens belong owing to the condition of the marginal bulbs. These bulbs are elongated, and vary in length. They may be cirri in a state of contraction, or minute tentacles unlike the large ones, or genuine bulbs. I am in favour of their being contracted cirri. The sense organs are small, about large enough to contain a couple of otoliths, and are probably open sensory pits ; if so, the specimens would belong to the Mitrocomidæ. The tentacles are not always equidistant apart, hence the irregular number of bulbs between them. One specimen has a quadrant containing six tentacles.

27. Leptomedusa, No. 3.

Localities. Nazareth Bank, Cargados Carajos, Surface. 30 Aug. 1905, i. 1 specimen. Amirante Isles, Surface. 18 Oct. 1905, oo. 3 specimens.

Description :—Umbrella rather flat, about 3 mm. in diameter. Stomach small and flat, similar to that of a *Phialidium*. Four radial canals (one specimen with five canals) without branches. Gonads sausage-shaped, along nearly the whole length of the radial canals. One specimen has conspicuous ripe ova. Tentacles small and slender, about 40, and terminating with a small cluster of nematocysts. No signs of cirri, or rudimentary marginal bulbs between the tentacles. No sense organs of any kind could be found.

All the specimens have rather a macerated appearance, and consequently it is not safe to rely upon the absence of sense organs.

Trachomedusæ.

28. Olindias singularis, Browne, 1904.

Olindias singularis, Browne, 1904, p. 737, pl. 56, fig. 2, pl. 57, fig. 1.
Olindias singularis, Bigelow, 1909, p. 109, pl. 4, fig. 1, pl. 31, figs. 1—10, pl. 32, fig. 8.
Olindias singularis, Mayer, 1910, p. 357.

Locality. Chagos Archipelago, Diego Garcia. 10—14 fms. 10 July, 1905. 4 specimens.

This species was first described by me from a single specimen, which Professor Stanley Gardiner found on his expedition to the Maldive Archipelago.

The chief specific character was based upon the presence of a single sense organ at the base of the primary tentacles. All the other species of the genus having a pair of sense organs in that position.

Bigelow fortunately found no less than 23 specimens in Managreva Harbour, Paumotu Archipelago in the Tropical Pacific, and he has given a more adequate description of the species, accompanied by excellent figures. In that series of specimens Bigelow noticed that the presence of a single sense organ did not hold good, for in the largest specimens (30—60 mm. in diameter) single and paired sense organs were found in the proportion of about four to one.

On searching the margin of the umbrella of the specimens from Diego Garcia I could find only a single sense organ at the base of the primary tentacles in three specimens, but the fourth specimen showed the presence of pairs. In quadrant (A) thirteen singles occurred, in quadrant (B) twenty-three singles and two pairs, in quadrant (C) twelve singles and five pairs, in quadrant (D) thirteen singles. It will be noticed that one quadrant is more prolific in pairs than the others, and that two quadrants are without pairs.

In these specimens the umbrella is somewhat flattened out, and measures 17 to 22 mm. in diameter. There are about seven centripetal canals in each quadrant. All the specimens show a fair quantity of primary tentacles, but the secondary tentacles have all but disappeared. It was not until a special search was made for them that a few, at a very early stage of development, were found. The fully grown secondary tentacles were probably broken off in the net, and now only their stumps remain. All the four specimens have gonads well developed.

In my report on the Maldive medusæ I stated that the primary tentacles of *Olindias* did not possess adhesive pads or suckers, and included their absence amongst the generic characters. Mayer and Bigelow have, however, proved the presence of adhesive pads in *Olindias tenuis*, and no doubt they occur in all the species of the genus. The error on my part arose from using sections of material which had not been specially preserved for that purpose. I failed to distinguish the adhesive cells, and on finding plenty of nematocysts came to the conclusion that the primary tentacles terminated with a battery of nematocysts.

Distribution. Tropical Pacific and Indian Oceans.

29. Rhopalonema velatum, Gegenbaur, 1856.

Rhopalonema velatum, Maas, 1893, p. 14, Taf. 1, figs. 5, 9—11.
Rhopalonema velatum, Vanhöffen, 1902, p. 59, Taf. 10, fig. 16, Taf. 11, fig. 32.
Rhopalonema velatum, Lo Bianco, 1904, p. 55, Taf. 34, fig. 137.
Rhopalonema velatum, Maas, 1905, p. 50, Taf. 10, fig. 69.
Rhopalonema velatum, Bigelow, 1909, p. 129.
Rhopalonema velatum, Mayer, 1910, p. 378, text-figs. 214, 216, 218, 219.
Rhopalonema velatum, Vanhöffen, 1912, p. 29.
Rhopalonema velatum, Vanhöffen, 1912, p. 371.

Localities. Chagos Archipelago; Mauritius; Farquhar Group; Amirante Isles. (The collection contained about sixty specimens taken at about twenty different stations.)

The specimens collected by the "Sealark" are about 2 to 5 mm. in diameter, and in different stages of development; the larger specimens have quite ripe gonads. The gonads form elongated swellings, not exceeding one millimetre in length and are usually situated about the middle of the radial canals. In shape these gonads are very similar to those of *Rhopalonema velatum* from Naples.

Rhopalonema velatum and *Rhopalonema cœruleum* have one character in common, namely, a conical top-knot on the summit of the umbrella. Bigelow found the top-knot to be very constant in his Pacific specimens. Although, at first, the top-knot was not regarded as of any importance, later its absence became useful for distinguishing *Rhopalonema funerarium*, Vanhöffen, from the other species of the genus. Nearly all the specimens in the "Sealark" collection show clearly the top-knot on the summit of the umbrella, but a few do not. The top-knot when properly formed stands out as a kind of conical projection on the top of the umbrella, and is usually marked off from the rest of the umbrella by a transverse circular furrow or depression. In shape and size it varies considerably, and is scarcely recognisable in extreme cases, as only a slight depression in the contour of the upper part of the umbrella is present. In this collection there are a few specimens which show no signs of a depression. These specimens are about 5 mm. in diameter, with well-developed gonads, and have rather a conical-shaped umbrella. Although certain specimens have not the characteristic top-knot, still there is not sufficient evidence to connect them with *Rhopalonema funerarium*. This latter species has a differently shaped umbrella and apparently does not begin to develop its gonads until about 6 mm. in diameter, and the gonads extend over the outer two-thirds of the radial canals. It lives at a greater depth than *Rhopalonema velatum*, and belongs to the mesoplankton.

According to Vanhöffen *Rhopalonema velatum* has eight perradial tentacles, eight interradial cirri, sixteen adradial cirri, and eight sense organs adjacent to the interradial cirri. Certain authors, however, have described and figured *Rhopalonema velatum* with sixteen sense organs. Maas (1893) gives the number of sense organs as sixteen, and figures two octants with three sense organs in each, thus showing that the number may even exceed sixteen. Mayer (1910, p. 380) gives a figure of *Rhopalonema velatum* drawn by himself at Naples, and it shows clearly sixteen sense organs, eight adjacent

to the perradial tentacles, and eight adjacent to the interradial cirri. Bigelow (1909) could only find eight sense organs in specimens collected in the Eastern Pacific.

There should be no difficulty in seeing sense organs in living specimens, but after specimens have been preserved for some time the sense organs frequently have a marvellous way of either disappearing or so changing their appearance that it is not an easy matter to recognise them. Among the specimens in the "Sealark" collection I have found three with sense organs adjacent to the perradial tentacle and in one of the specimens the root of the adradial cirrus was visible. The tentacles and cirri are broken off in most of the specimens. When any are present it is the interradial cirrus. Only about three specimens have any perradial tentacles left and the adradial cirri have either not developed or else broken off at the base.

Rhopalonema velatum is widely distributed throughout the warm regions of all the oceans. It is generally found at or near the surface.

Bigelow (1909) after an examination of a large series of specimens collected by the "Albatross" in the Eastern Tropical Pacific, has come to the conclusion that *Rhopalonema velatum*, Gegenbaur, and *Rhopalonema cæruleum*, Haeckel, are identical. In 1906, when I reported upon specimens of *Rhopalonema cæruleum* collected in the Bay of Biscay, I certainly felt sure that *Rhopalonema velatum* and *Rhopalonema cæruleum* were distinct species. The distinguishing character was based upon the shape of the gonads, which in *Rhopalonema velatum* are either globular or oval, but in the Biscayan *Rhopalonema cæruleum* the gonads form narrow bands, which occupy the central third of the radial canals. Although I have re-examined the Biscayan specimens, still I am not yet convinced that they are identical with *Rhopalonema velatum*.

Mayer (1910, p. 380) regards *Rhopalonema cæruleum*, Haeckel, as a distinct and good species. Under its name he has placed the following:—*Rhopalonema cæruleum*, Maas (1905); Browne (1906). *Rhopalonema funerarium*, Vanhöffen (1902); Bigelow (1909). Bigelow considers the *Rhopalonema cæruleum*, Haeckel and Browne, to be identical with *Rhopalonema velatum*, Gegenbaur. Mayer, on the other hand, regards it as identical with *Rhopalonema funerarium*. I cannot agree with Mayer's synonymy, for, I believe, that he has mixed up two distinct species; *Rhopalonema cæruleum*, Haeckel and Browne, belongs to one species, and *Rhopalonema funerarium*, Vanhöffen (1902), Bigelow (1909); *Rhopalonema cæruleum*, Maas (1905) belong to another species.

30. Sminthea eurygaster, Gegenbaur, 1856.

Sminthea eurygaster, Gegenbaur, 1856, p. 245, Taf. 9, figs. 14—15.
Trachynema eurygaster, Haeckel, 1879, p. 260.
Trachynema mammæforme, Haeckel, 1879, p. 262, Taf. 17, figs. 13—15.
Sminthea eurygaster, Metschnikoff, 1886, p. 244, Taf. 1, figs. 18—20.
Trachynema eurygaster, Maas, 1893, p. 12.
Trachynema eurygaster, Browne, 1906, p. 171.
Sminthea eurygaster, Mayer, 1910, p. 383, text-figs. 226—227.

Localities. North of Chagos, Lat. 4° 16′ S., Long. 71° 53′ E. 125—0 fms. 17 May, 1905, B. 1 specimen. 50—0 fms. 18 May, 1905, F. 2 specimens. Chagos Archipelago,

Peros Atoll. 75—0 fms. 30 June, 1905, M. 1 specimen. Amirante Isles, Desroches. 100—0 fms. 16 Oct. 1905, kk. 1 specimen.

Mayer (1910) has revived the old generic name *Sminthea* of Gegenbaur and defines the genus as follows :—"Trachymedusæ with only eight tentacles, one at the foot of each of the eight radial canals. In other respects this genus is similar to *Rhopalonema*." The chief advantage in the use of the name *Sminthea* is that it has a good type species, known as *Sminthea eurygaster*. It is quite easy to recognise this species when the gonads are present as they form globular swellings on the radial canals adjacent to the margin of the umbrella. In the early stages with the gonads undeveloped, it is necessary to rely upon the absence of any intercanal tentacles or cirri, and take the risk of their being early stages belonging to another genus.

The specimens in the "Sealark" collection are between 2 to 3 mm. in diameter and some have gonads. The tentacles are all broken off at their base.

This is rather a rare medusa. It has been previously recorded from the Mediterranean and the Atlantic. Its southernmost record in the Atlantic being in the South Equatorial Current off the north coast of Brazil.

31. Pantachogon rubrum, Vanhöffen, 1902.

Pantachogon rubrum, Vanhöffen, 1902, p. 63, Taf. 9, fig. 9, Taf. 10, figs. 19—20.
Pantachogon rubrum, Maas, 1905, p. 55, Taf. 10, fig. 66.
Pantachogon rubrum, Mayer, 1910, p. 389, text-figs. 240—241.

Localities. Chagos Archipelago, off Peros Banhos, 600—0 fms. 30 June, 1905, N. 1 specimen. Between Providence Is. (Farquhar Group), and Alphonse Is., Lat. 8° 16′ S., Long. 51° 26′ E. 900—0 fms. 6 Oct. 1905, aa. 1 specimen.

Unfortunately both specimens are in bad condition, but it is just possible to determine the species. The umbrella is dome-shaped, with an evenly rounded summit, about 7 mm. in width and 5 mm. in height. The stomach is about 2 mm. long, without a peduncle, and its mouth has four short lips. The gonads are evidently just beginning to develop on the lower half of the eight radial canals. The tentacles are indicated by their stumps, and there are evidently eight in each octant.

The second specimen is of about the same size and shape as the first one. It is, however, in far worse condition, but useful as it shows a certain amount of bright reddish coloration on the sub-umbrella.

Distribution. Widely distributed in the warm regions of the Atlantic and Indian Oceans, and belonging to the mesoplanktonic zones.

32. Halicreas papillosum, Vanhöffen, 1902.

Halicreas papillosum, Vanhöffen, 1902, p. 68, Taf. 9, figs. 7—8, Taf. 11, fig. 30.
Halicreas papillosum, Maas, 1905, p. 57, Taf. 10, fig. 70, Taf. 11, fig. 71.
Halicreas papillosum, Bigelow, 1909, p. 138, pl. 3, fig. 3, pl. 33, figs. 8—9, pl. 34, figs. 1—3, 5, 8, 10, 11.
Halicreas papillosum, Mayer, 1910, p. 391, figs. 242—243.

Localities. South of Farquhar Group, Lat. 10° 27′ S., Long. 51° 17′ E. 1000—0 fms. 27 Sept. 1905, q. 3 specimens. North of Farquhar Group, Lat. 8° 16′ S., Long. 51° 26′ E.

900—0 fms. 6 Oct. 1905, aa. 2 specimens. Amirante Isles. 750—0 fms. 16 Oct. 1905, ll. 3 specimens. 16 Oct. 1905, mm. 400—0 fms. 2 specimens.

All the specimens are in very bad condition, and but little better than clear lumps of jelly.

This species has been very rarely taken near the surface, and it evidently belongs to the mesoplanktonic zone.

Distribution. Throughout the tropical and sub-tropical regions of all the oceans.

33. Aglaura hemistoma, Péron et Lesueur, 1809.

Aglaura hemistoma, Haeckel, 1879, p. 275, Taf. 16, figs. 3—4.
Aglaura hemistoma, Maas, 1893, p. 25, Taf. 1, figs. 12—13.
Aglaura hemistoma, Vanhöffen, 1902, p. 78.
Aglaura hemistoma, Lo Bianco, 1904, p. 55, Taf. 34, fig. 138.
Aglaura hemistoma, Browne, 1906, pp. 176, 184.
Aglaura hemistoma, Bigelow, 1909, p. 119, pl. 2, fig. 6.
Aglaura hemistoma, Mayer, 1910, p. 398, pl. 46, figs. 4—5, pl. 49, figs. 3—7, pl. 50, fig. 11, text-figs. 250—251.
Aglaura nausicaa, Haeckel, 1879, p. 274, Taf. 16, fig. 1.
Aglaura hemistoma var. *nausicaa*, Maas, 1893, p. 26.
Aglaura hemistoma var. *nausicaa*, Mayer, 1910, p. 400, fig. 252.
Aglaura laterna, Haeckel, 1879, p. 274, Taf. 16, fig. 2.
Aglaura hemistoma var. *laterna*, Maas, 1893, p. 25, Taf. 1, fig. 14.
Aglaura hemistoma var. *laterna*, Mayer, 1910, p. 400, fig. 253.
Aglaura prismatica, Maas, 1897, p. 24, Taf. 3, figs. 4—5.
Aglaura prismatica, Agassiz and Mayer, 1899, p. 165, pl. 4, fig. 13.
Aglaura hemistoma var. *prismatica*, Mayer, 1910, p. 400.
Aglaura octogona, Bigelow, 1904, p. 257, pl. 2, fig. 9.
Aglaura hemistoma var. *octogona*, Mayer, 1910, p. 401.

For further synonyms and references see Mayer, 1910, pp. 397—401.

Localities. North of Chagos; Off Mauritius; North of Saya de Malha Bank; Farquhar Group; Alphonse Is.; Amirante Isles. (The collection contained about 120 specimens taken at 21 different stations.)

After the cruise of the "Valdivia" Vanhöffen came to the conclusion that only one species of *Aglaura* existed. Bigelow on the "Albatross" cruise in the Eastern tropical Pacific paid special attention to *Aglaura* by examining specimens alive, and he also has decided in favour of a single species. Mayer is of the opinion that only one species exists, but he retains in his monograph the names of the varieties.

Aglaura hemistoma belongs to the epiplanktonic fauna, and is widely distributed throughout the warm regions of all oceans and seas. In the Biscayan Plankton (Browne, 1906) it was most plentiful at about 50—100 fms, scarcest at the surface. It did not occur in closing nets below 100 fms. On the "Sealark" expedition Professor Gardiner used the Wolfenden closing-net at only three stations and at each *Aglaura hemistoma* was taken. It occurred once at 250 fms, and twice at 500 fms. The serial hauls taken with open nets from different depths gave no reliable clue, owing to the paucity of specimens, as to the depth at which the species was most abundant. On each occasion the nets used within 50 fms of the surface contained specimens, and the numerous surface tow-nettings showed that it was not uncommon at the surface.

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Most of the specimens are in good condition and resemble figures given by Maas (1893, Taf. 1, figs. 12—14). The umbrella having its length greater than its width, but in a few the length and width are about equal. None exceeded 3 mm. in length. The peduncle showed great variability in its length. In some specimens it is scarcely visible owing to contraction, whilst in others it reaches halfway down the cavity of the umbrella. The gonads at an early stage are globular, and become cylindrical or sausage-shaped when fully grown.

34. Amphogona apsteini (Vanhöffen) 1902.

Pantachogon apsteini, Vanhöffen, 1902, p. 65, Taf. 10, fig. 18, Taf. 11, fig. 28.
Amphogona apsteini, Browne, 1904, p. 740, pl. 54, fig. 5, pl. 56, fig. 1, pl. 57, figs. 10—15.
Amphogona apsteini, Bigelow, 1909, p. 126, pl. 2, figs. 1—2, pl. 34, figs. 12—15, pl. 45, fig. 10.
Amphogona apsteini, Mayer, 1910, p. 405, text-fig. 257.

Localities. North of Chagos, Surface. 18 May, 1905, H. 1 specimen. Cargados Carajos, Surface. 30 Aug. 1905, i. 3 specimens. Farquhar Group, Surface. 2 Oct. 1905, x. 5 specimens.

Hermaphroditism occasionally occurs in this species and as such a feature is very rare amongst the Hydromedusæ it breaks the monotony of the usual descriptions. I first noticed (1904) in specimens collected by Professor Gardiner from the Maldives Islands; the male and female gonads alternating with one another in the radial canals.

Bigelow on the cruise of the "Albatross" in the Eastern Pacific found six specimens in Acapulco Harbour. These specimens turned out to be unisexual, all the gonads of any given individual being either male or female.

Hartlaub (1909, p. 462, Taf. 21, fig. 27) has described a new species under the name of *Amphigona pusilla* from Djibuti in the Gulf of Aden. One specimen showed hermaphroditism, and the other was unisexual and female.

In the "Sealark" collection one specimen shows three gonads, similar in shape and size on adjacent canals, and they have every appearance of being males, so it may be presumed that this specimen is unisexual. Another specimen shows large and small gonads alternating with one another, as figured by Vanhöffen, but they are too immature for the determination of the sex. The other specimens have either lost or nearly lost all their gonads and are useless for this purpose.

The specimens are about 2·5 mm. to 4·5 mm. in diameter, and have their stomach upon a peduncle, which varies in length according to the size of the specimen and the amount of contraction. The smallest specimen has about six tentacles, and the largest eight tentacles in each octant. The sense organs have all disappeared.

Distribution. Previously recorded from Indian Ocean, Maldive Is.; West coast of Sumatra. Pacific Ocean; Acapulco Harbour (Mexico).

Genus Liriope, Lesson, 1843.

This is a difficult genus for finding reliable specific characters. The character which has usually been selected is the shape of the gonads. If the gonads be taken for the sole character, then it is possible to connect together specimens with linear gonads, through

a series of oval and ovoid forms, on to specimens with heart-shaped and triangular gonads, providing that the specimens are sufficiently numerous and taken over a large area. This method of determination leads to a considerable reduction in the number of described species, and practically it means that the genus should have only a single species.

Another character which has been used as an aid to the determination of species is the number of centripetal canals. These increase in number by age and by the growth of the umbrella, so that taken alone they are not very reliable. Other characters have also been used, such as the length of the peduncle and the shape of the umbrella. By taking each character separately one can connect together specimens which have every appearance of being quite distinct species.

Some of the species have no doubt been described from single specimens, every character has been used for the purpose, especially the shape of the gonads and no allowance made for variation or growth. Apparently a description and figure based upon a single or just a few individuals are not sufficient in the case of *Liriope*. It has, however, occurred to me that by taking a sufficient number of adults at the same place and time, and using all the possible characters, one would be able to obtain an impression of the type of that particular lot of specimens, and produce a sketch not of an individual but of the characters of the type. By adopting this method I think there is a chance of isolating species or at all events local races.

The number of specimens in the "Sealark" collection was not sufficient for finding out the exact number of local races or species living within the area covered by the voyage. After rejecting early stages and bad specimens the number left for the purpose was small. I am able, however, to isolate two races or species, and got on to the track of a third one.

35. Liriope tetraphylla (Chamisso et Eysenhardt) 1821.

The specimens with triangular gonads I have placed under the old name of *Liriope tetraphylla*, and they are very similar to Vanhöffen's figure of *Liriope tetraphylla* (1902, Taf. 10, fig. 14).

The umbrella is thin, 5—8 mm. in diameter. The length of the peduncle is about twice the diameter of the umbrella. Velum very broad. In each quadrant there are three centripetal canals, the interradial the longest extending up to or nearly to the top of the gonads, the adradial canals about half the length of the interradial. The gonads are of the triangular type, about equilateral, either with angular or rounded corners and do not extend down to the margin of the umbrella.

36. Liriope, sp. ?

The second species or race I leave without a name, as I have not been able to find a published figure showing the characters of the race, and the condition of the specimens is not suitable for drawing.

The umbrella is thin, about 5 mm. in diameter. The peduncle is a little longer than the diameter of the umbrella. Only one centripetal canal (interradial) in each quadrant. The gonads are longer than they are broad, either oval or elongated shield-shaped.

The great differences between the two species are in the shape of the gonads and

in the number of centripetal canals. The specimens with triangular gonads have always three centripetal canals in each quadrant, even in the intermediate stages when the gonads are beginning to develop. The specimens with elongated oval gonads have only one centripetal canal in each quadrant and the gonads begin as linear enlargements of the radial canals.

Liriope was found at 27 stations. A good haul was made north of Chagos (17 May, 1905, C.) when 78 specimens were taken. These were mostly early stages with a few adults of *Liriope* sp. Another large haul of the same species was made at the Farquhar Isles (1 Oct. 1905, v.). Except at these two stations *Liriope* was rather scarce.

37. Geryonia proboscidalis (Forskål) 1776.

Geryonia proboscidalis, Vanhöffen, 1902, p. 84, Taf. 10, fig. 15.
Geryonia proboscidalis, Bigelow, 1909, p. 116.
Geryonia proboscidalis, Mayer, 1910, p. 425, pl. 53, figs. 1—3, pl. 54, fig. 10, text-fig. 282.
Geryonia hexaphylla, Maas, 1897, p. 26, Taf. 3, fig. 6.
Carmarina hastata, Haeckel, 1865, p. 74, Tafs. 1, 4, 5.
Carmarina hastata, Lo Bianco, 1904, p. 56, Taf. 35, fig. 140.
Geryones mexicana, Agassiz and Mayer, 1902, p. 149, pl. 4, fig. 17.
Carmaris rosea, Agassiz and Mayer, 1902, p. 149, pl. 4, fig. 18.

For further synonyms and references see Mayer, 1910, p. 425.

Localities. North of Chagos, 1200—0 fms. 17 May, 1905, C. 1 specimen. Chagos Archipelago, Salomon Atoll, 10 fms. 1 July, 1905, P. 1 specimen. Mauritius, 300—0 fms. 22 Aug. 1905, c. 1 specimen.

The specimens are early stages and not in good condition. The smallest, about 3 mm. in diameter, has one centripetal canal in each interradius, and the perradial hollow tentacles are just beginning to develop. The largest specimen, about 8 mm. in diameter, has three centripetal canals in each interradial sextant. The gonads are beginning to develop. Two of the sense organs have two otoliths instead of the usual single one.

Distribution. At the surface in the tropical and warm regions of all the Oceans, and in the Mediterranean.

NARCOMEDUSÆ.

38. Solmaris sp. ?

Localities. North of Chagos, Surface (Temp. 82° F.). 18 May, 1905, F. 1 specimen. Chagos Archipelago, Salomon Atoll, Surface. 4 July, 1905, Q. 3 specimens. Farquhar Is., Surface. 29 Sept. 1905, u. 1 specimen.

Out of the five specimens taken only one is in moderately good condition, and it is the largest.

Description:—The umbrella is about 5 mm. in diameter, slightly curved, and moderately thin. The marginal lappets are about as broad as long, and curved on the outer edge. Velum narrow. The stomach is circular, its lower wall rather loose, and the mouth closed in the form of projecting lips. There are broad marginal canals, but not

in the form of a solid chord of cells. The gonads are developing on the outer third of the lower wall of the stomach in a continuous ring, which is without any projecting pouches. There are eight tentacles, about as long as the diameter of the umbrella; they are not very stiff, and taper to a fine point. Below each tentacle is a well-marked peronial groove, lined with nematocysts. On each of the eight marginal lappets are five sense organs, rather ovate in shape, showing a clear circular vesicle, and without any external hairs. Otoporpæ are present as narrow bands just curling over the margin of the umbrella and situated on ridges.

The other specimens are smaller in size and very much contracted. Two of them have nine tentacles.

It is difficult to assign a specific name to these specimens, as some are certainly quite young stages and the largest has not reached maturity. They come nearest to Haeckel's *Solmaris lenticula* from the Indian Ocean. This species was only briefly described and never figured by Haeckel. Mayer thinks that it was probably only an immature form.

39. Ægina citrea, Eschscholtz, 1829.

Ægina citrea, Maas, 1905, p. 71, Taf. 11, fig. 72, Taf. 13, figs. 79—82.
Ægina citrea, Bigelow, 1909, p. 73, pl. 1, fig. 5, pl. 14, fig. 5.

Locality. Chagos Archipelago, Peros Atoll. 600—0 fms. 30 June, 1905, N. 1 specimen.

I am not certain about the correct determination of this specimen, which is far from being perfect. The umbrella has a rather rounded summit, and measures 14 mm. in width and 7 mm. in height. There are eight stomach-pouches, one of which shows signs of a small notch in the middle of the lower edge; the other pouches are either without a notch or in an imperfect condition. Four tentacles about 30 mm. long. The margin of the umbrella is imperfect, but four sense organs were seen in one octant.

Genus Solmundella, Haeckel, 1879, ex Maas, 1904.

This genus is found in all the oceans from the tropics to the icy waters of the poles. It is quite easy to determine the genus even from very bad specimens, but one has yet to settle the exact number of species, and this delicate point is not so easily disposed of.

Vanhöffen considers that the genus has only a single species, which he calls *Solmundella bitentaculata*, after the oldest specific name. The doubtful species is known as *Solmundella mediterranea*. Whether this is a good species, or a variety of *Solmundella bitentaculata* or identical with it, is a point which, in my opinion, requires further researches.

Maas and Bigelow evidently recognise two species; Mayer is very doubtful, and only ranks *Solmundella mediterranea* as a variety. As in the case of *Liriope*, I think that there are at least local races of *Solmundella*. The difficulty is to make sure of their status. Are they distinct species or varieties? If it should be finally decided that there is only one species, then I think that local races should be recognised by names for the sake of geographical distribution.

The Antarctic race has a character which has not been described in specimens from other places. Both Vanhöffen and myself note the occurrence of clusters of nematocysts upon the ex-umbrella, especially near the margin. If these clusters are not found in specimens from other localities they could be used to isolate the Antarctic race. The English and German expeditions to the Antarctic found *Solmundella* very plentifully at their respective winter quarters, and it apparently stays there and breeds there throughout the year. Though we both found the same race, still we called it by different names. Vanhöffen regarded it as *Solmundella bitentaculata* on account of his recognising only a single species, whereas I tried to separate it from that species and called it *Solmundella mediterranea* on account of its possessing only eight sense organs. The number of sense organs has generally been used to separate the two species. *Solmundella mediterranea* usually with eight sense organs and not more than sixteen, whereas *Solmundella bitentaculata* may have double that number. The sense organs alone are hardly sufficient to separate the two species because *Solmundella bitentaculata* passes through stages with eight and sixteen sense organs. The shape of the umbrella may be useful when one is examining living specimens or specimens preserved in perfect condition; the latter, however, are not often found in collections from abroad.

40. Solmundella mediterranea (Müller) 1851.

Solmundella mediterranea, Maas, 1906, p. 12, Taf. 1, fig. 5, Taf. 3, figs. 23—24.
Solmundella mediterranea, Browne, 1910, p. 38.
Solmundella bitentaculata var. *mediterranea*, Mayer, 1910, p. 456, pl. 54, figs. 1—3, pl. 55, fig. 4.

Localities. North of Chagos, Surface (Temp. 84° F.). 16 May, 1905, A. 2 specimens. 50—0 fms. 18 May, 1905, F. 1 specimen. Chagos Archipelago, Salomon Atoll, Surface. 5 July, 1905, Q. 4 specimens. Farquhar Group, Surface. 3 Sept. 1905, x. 3 specimens. Amirante Isles, Desroches Atoll. 50—0 fms. 16 Oct. 1905, kk. 2 specimens. Amirante Isles, Surface. 18 Oct. 1905, oo. 1 specimen.

I have decided to place the "Sealark" specimens under the name of *Solmundella mediterranea* as the best and largest specimen comes nearest to it. The umbrella is highly arched, about 3 mm. in diameter, with isolated nematocysts scattered over the ex-umbrella. The gonads are confined to the pouches and show ripe ova. The tentacles are 13 mm. in length. There are nine sense organs, with otoliths, and four interradial marginal bulbs. The other specimens are of little value for specific determination, being either early stages or damaged. One specimen has *Cunina*-buds inside the stomach.

41. Cunina sp.?

Localities. North of Chagos. Chagos Archipelago. Farquhar Alphonse Is. Amirante Is.

The collection contains about 50 specimens taken at nine different stations.

Nearly all the specimens of *Cunina* belonged to early stages, about 3 mm. in diameter. Most of them have 8 tentacles, and a few have 7, 9 or 10 tentacles. They are in rather bad condition and probably represent more than one species.

At a station, North of Chagos, a series larger in size was taken, and had the

specimens been in better condition I might have succeeded in determining the species. In general appearance they resemble Gegenbaur's figure of *Cunina lativentris* (Gegenbaur, 1856, Taf. 10, fig. 2). The largest specimen measures 8 mm. in diameter, and its umbrella is moderately thick. It has twelve tentacles, about 3 mm. long, tapering to a fine point; at their base is a semicircular band of nematocysts. The gastric pouches are about as broad as long, with gonads in the course of development, and in shape somewhat similar to Gegenbaur's figure. The otoporpæ take the form of short narrow lines, situated on ridges, four to five on each lappet.

SCYPHOMEDUSÆ.

CHARYBDÆIDÆ

42. Charybdea sp. ?

Locality. Farquhar Group, Surface. 2 Oct. 1905, x. 1 specimen.

This single specimen is immature, and at a stage which makes identification so very uncertain that it is perhaps best not to give it a specific name.

The umbrella is 15 mm. wide and 23 mm. high, and tapers very slightly towards the summit, which is slightly rounded. The ex-umbrella is free from warts and clusters of nematocysts. The stomach is very short and rather flat; the mouth has four lips. The phacellæ or gastric filaments are neither arranged in groups nor branched, but each interradial set is composed of simple filaments. The velarium has six unbranched canals in each quadrant. There are four tentacles, with pedalia about 7 mm. in length, and having a flat spatula-like expansion on the inner side. The gonads are immature, about 11 mm. in length, and do not extend so far down as the plane of the sense organs. The four perradial sense organs are situated about 4 mm. above the margin of the umbrella, and the sensory clubs are suspended by a stalk in a deep pit, which projects out on the wall of the sub-umbrella. The sensory clubs have two ocelli, one of which is very large and nearly terminal, the other is above it, close to the stalk, and is very much smaller. These are the median ocelli, but no lateral ocelli could be detected.

CORONATÆ.

43. Nausithöe punctata, Kölliker, 1853.

Nausithöe punctata, Bigelow, 1909, p. 35, pl. 12, fig. 5.
Nausithöe punctata, Mayer, 1910, p. 554, pl. 60, figs. 4—5.
Nausithöe punctata, Bigelow, 1913, p. 85.

Localities. North of Chagos. Chagos Archipelago. Amirante Isles.

The collection contains 16 specimens taken at eight different stations.

The specimens are rather small, not exceeding 5 mm. in diameter. Nearly all the specimens have globular gonads, about equidistant apart. Two specimens, however, have oval gonads, about twice as long as broad.

This medusa inhabits the tropical and warm regions of all the oceans, and belongs to the surface fauna.

Genus Atolla, Haeckel, 1880.

After reading the work of Bigelow (1909 and 1913), Mayer (1910) and Broch (1913) on *Atolla*, it seems to me that the genus has only two species, namely, *Atolla wyvillei* and *Atolla chuni*. The latter is easily distinguished by the presence of warts on the marginal lappets. All the other species which have been described by various authors apparently fall under the oldest name of *Atolla wyvillei*. The presence and shape, or the absence, of radial furrows on the central disc, formerly relied upon for distinguishing species, are apparently worthless as specific characters.

Broch, after examining over 200 specimens of *Atolla* collected by the "Michael Sars" in the North Atlantic, was able to separate the material into three groups.

"First, those furnished with distinct radial furrows all over the central disc; second, those with incomplete radial furrows, in many cases visible only at the margin of the central disc; and third, those with a perfectly smooth central disc, showing no trace whatever of radial furrows."..."The intermediate group contains every transition stage from *Atolla bairdii* (with a smooth central disc) to *Atolla verrillii* (with narrow radial furrows on the central disc), and we are therefore compelled to consider *Atolla verrillii* as a synonym of *Atolla bairdii*."

Out of this large number of *Atolla* Broch was able to isolate a single specimen, which he has placed under the name of *Atolla wyvillei*. "The broad and conspicuous radial furrows of the central disc and the strongly-marked longitudinal furrows of the pedalion distinguish this species from the other Atlantic species." Broch apparently found no connecting link between *Atolla wyvillei* and *Atolla verrillii*.

Bigelow, according to his reports on collections from the Eastern and North-Western Pacific regions, has experienced the difficulty of separating *Atolla wyvillei* (with broad radial furrows) from *Atolla verrillii* (with narrow radial furrows). He says: "In the Eastern Pacific specimens there was considerable variation in the breadth of the furrows, which were usually broad in large, narrow in small specimens." In the North-Western Pacific specimens "the furrows vary so much that no sharp line can be drawn between specimens in which they are broad and those in which they are narrow."

Bigelow records no specimens in these collections with a perfectly smooth disc (*Atolla bairdii*). It is clear from Broch's researches that the absence of or presence of radial furrows are not good characters for the determination of species, and from Bigelow's researches that the width of the radial furrows is also useless.

Broch also gives tables which show that there is no good evidence for assuming that the smooth-disc form of *Atolla* and the furrow-disc form are separate geographical races, or that they live at different depths, or that differences are due to growth. The two kinds are found together at the same stations, depth, and of the same size.

44. Atolla wyvillei, Haeckel, 1880.

Localities. N.E. of Chagos, Lat. 4° 30′ S., Long. 71° 15′ E. (Depth about 2000 fms.) 2 specimens caught in Fowler's self-closing net. 1000—500 fms. 18 May, 1905, J. Between Providence and Alphonse, Lat. 8° 16′ S., Long. 51° 26′ E. 1 specimen caught in a large square net. 900—0 fms. 6 Oct. 1905, aa.

The specimens are in bad condition. The smallest measured 7 mm. across the circular muscle band, and it is an early stage, with 20 tentacles. The largest is 30 mm. in diameter, across the circular muscle band and has 24 tentacles. The radial grooves on the margin of the central disc are well marked and belong rather to the type associated with *Atolla verrillii* than to *Atolla wyvillei*.

SEMÆOSTOMEÆ.

Genus Pelagia, Péron et Lesueur, 1809.

Pelagia is one of the genera which has its species in a state of confusion. There has been a general reduction in the number of species, and some of those which have been left are still uncertain. The characters selected for the determination of the species have not produced satisfactory results.

The classification based upon the warts on the ex-umbrella failed owing to their being treated too minutely, but I believe that they will yet prove useful for distinguishing races, if not species. Warts vary considerably in shape and size in each individual, but there is a predominating type which becomes characteristic of the race or species, and belongs to that particular race only. The predominance of high conical warts is characteristic of *Pelagia flaveola*. This type of wart does not occur in *Pelagia panopyra*, which has low oval-shaped warts; but minute roundish warts are common to both.

The marginal lappets in all the specimens which I have seen are too much alike in shape and size to be of any definite use for distinguishing species. The position and density of the warts on the lappets may be useful for distinguishing races.

Attempts have been made to distinguish species by the length and size of the manubrium and oral arms, but one never knows when examining preserved specimens how much the oral arms have contracted.

In the "Sealark" collection there are three distinct kinds of *Pelagia*. *Pelagia flaveola* I am in favour of recognising as a distinct species on account of its peculiar warts.

45. Pelagia panopyra (Péron et Lesueur) 1807.

Pelagia panopyra, Bigelow, 1909, p. 43.
Pelagia panopyra, Mayer, 1910, p. 575.
Pelagia panopyra, Kishinouye, 1910, p. 9.
Pelagia panopyra, Bigelow, 1913, p. 88.

Locality. South West of Chagos, Surface. 31 July, 1905. 5 specimens.

The specimens from this station have warts on the ex-umbrella marked by ridges and furrows. The warts form low mounds varying in shape from round to oval. The oval-shaped warts predominate and are characteristic. The ridges and furrows are formed in the jelly, and are clearly revealed where the ectodermal covering has been rubbed off. An oval-shaped wart has a longitudinal ridge with lateral ridges and furrows running

down at right-angles to the main central ridge. A roundish wart has ridges and furrows radiating out from the centre.

The specimens are from 20 to 25 mm. in diameter; the largest measured 25 mm. in width and 15 mm. in height. The umbrella is hemispherical in shape with a slightly flattened top, and moderately thick.

The marginal lappets are about as long as broad, with rounded corners. They are thin and partly covered with small roundish or oval patches of nematocysts. The oral arms are rather contracted, and have a firm solid appearance, about 15 mm. in length. The manubrium, oral arms, and frills, are covered with warts, usually oval in shape, but more variable in shape and size on the frills. On the margin of the umbrella, opposite every sense organ, there is a small shallow conical pit. The largest specimen has ova in the genital sacs.

46. Pelagia sp. ?. A.

Locality. South of Saya de Malha, Surface. 4 Sept. 1905, m. 1 specimen.

One specimen found amongst those of *Pelagia flaveola* by the shape of its warts clearly belongs to another species. It has a number of long and oval-shaped warts upon the ex-umbrella, which is in an excellent state of preservation and completely covered with ectoderm. The warts are very variable in shape and size, some are roundish. On the top of the warts there is a patch of nematocysts corresponding to the general shape of the raised warts. There are no clear indications of ridges and furrows in these warts. I am rather inclined to think that the appearance of ridges and furrows on the surface of the warts, which have been denuded of ectoderm, has some connection with a shrinkage of the jelly, and that they probably would not be noticed if the warts were completely covered with ectoderm.

The specimen measures about 12 mm. in diameter. The marginal lappets are loosely covered with small roundish or oval warts, which are confined to the areas occupied by the canals on the lappets. A shallow, roundish pit exists on the margin of the ex-umbrella, opposite each sense organ. This single specimen comes nearest to *Pelagia panopyra* on account of the presence of the oval-shaped warts.

47. Pelagia flaveola, Eschscholtz, 1829.

Pelagia flaveola, Eschscholtz, 1829, p. 76, Taf. 6, fig. 3.
Pelagia papillata, Haeckel, 1880, p. 509.
Pelagia tahitiana, Agassiz and Mayer, 1902, p. 158, pl. 8, figs. 34—35.
Pelagia flaveola, Mayer, 1910, p. 575, text-fig. 364.

Locality. South of Saya de Malha, Surface. 4 Sept. 1905, m. 24 specimens.

The specimens of *Pelagia* taken at this station can easily be distinguished from those taken at the other stations by the shape of the warts upon the ex-umbrella. The warts are formed of conical lumps of jelly capped with a small cluster of nematocysts, and they stand up conspicuously as figured by Agassiz and Mayer (1902, Pl. 8, fig. 34) for *Pelagia tahitiana*. The largest warts are upon the upper half of the umbrella and they decrease

in size towards the margin. There is a considerable variation, both in shape and size of the warts, due either to pressure or to a shrinkage of the jelly. The latter produces strange effects, such as a wart having the appearance of being surmounted by a small capitate tentacle, or the ex-umbrella being covered with tentacular-like papillæ clearly visible to the naked eye. It is quite easy to distinguish this species by the shape of the warts provided that the specimens are in good condition, but there is a good chance of a failure if the warts are squeezed out of shape by pressure.

The description of *Pelagia tahitiana* by Agassiz and Mayer agrees so well with my specimens that I cannot find anything of importance to add to it, and as Mayer considers that *Pelagia tahitiana* is identical with *Pelagia flaveola* of Eschscholtz I have followed his synonymy.

The size of the specimens in the "Sealark" collection is from 10 to 25 mm. in diameter with the umbrella flattened out. A few large specimens have immature gonads hanging down from the sub-umbrella. All the specimens are colourless in formaline, but they should have been yellowish when alive. The oral arms of all the specimens are in bad condition. They are apparently only very thinly covered with small patches of nematocysts upon slight elevations of jelly. There is a small pit on the margin of the umbrella opposite each sense organ.

Some of the specimens have small barnacles attached to the ex-umbrella.

Distribution. Tropical Pacific and Indian Oceans.

48. Pelagia sp.?. B.

Locality. North of Chagos, Lat. 4° 16′ S., Long. 71° 53′ E. 75—0 fms. 17 May, 1905, B. 1 specimen. Surface. 18 May, 1905, B. 6 specimens. 75—0 fms. 18 May, 1905, B. 2 specimens.

The warts on the ex-umbrella of these specimens are low and roundish, with a broad patch of nematocysts in the centre. These warts show no traces of ridges and furrows, and none are oval-shaped as seen in *Pelagia panopyra*. In one specimen in a depression at the top of the umbrella some of the warts are rather taller than the others, suggesting a resemblance to the warts of *Pelagia flaveola*.

The specimens measured from 7 to 13 mm. in diameter. The umbrella has a flattish top, nearly twice as broad as high and moderately thick. The marginal lappets are about as long as broad, with rounded corners, and well covered with rounded patches of nematocysts. The manubrium and oral arms are rather longer than in *Pelagia panopyra* and thickly covered with roundish patches of warts. There is a shallow pit on the ex-umbrella, opposite every sense organ. The gonads are only just beginning to develop in the larger specimens.

RHIZOSTOMÆ.

49. Cassiopea andromeda var. maldivensis, Browne, 1905.

Cassiopea andromeda var. *maldivensis*, Browne, 1905, p. 962.
Cassiopea andromeda var. *maldivensis*, Mayer, 1910, p. 963.

Locality. Seychelles Group. Praslin Reef. 2 specimens.

These specimens agree fairly well with the description of the variety which I described from the Maldives.

The umbrella of the largest specimen measured 110 mm. when flattened out, and the smaller one measured 80 mm. in diameter. The ex-umbrella is quite smooth, without any trace of a circular band, and without any colouration markings. The margin of the umbrella is too imperfect for counting the number of lobes. The largest specimen has at least 18 sense organs, which are very irregular in position. The oral arms are provided with appendages very similar to those described in Maldive specimens. The small appendages adjacent to the oscula are either leaf-shaped or cylindrical. In addition to these appendages there are a few others very much larger. One in the very centre of the oral disc measured 22 mm. in length and 7 mm. in width; others near it are shorter and more cylindrical. Both specimens are thickly covered with Green Cells or Zooxanthellæ.

LIST OF BOOKS AND MEMOIRS QUOTED IN THE TEXT.

Agassiz, A., and A. G. Mayer, 1899. "Acalephs from the Fiji Islands." Bull. Mus. Comp. Zool., Harvard College, vol. 32, pp. 157—189, 17 pls.

—— 1902. "Reports on the Scientific Results of the Expedition to the Tropical Pacific...in the 'Albatross'." Part III. Medusæ, Memoirs Mus. Comp. Zool., Harvard College, vol. 26, pp. 139—176, pls. 1—13.

Bigelow, H. B., 1904. "Medusæ from the Maldive Islands." Bull. Mus. Comp. Zool., Harvard College, vol. 39, pp. 245—269, 9 pls.

—— 1909. "Reports on the Scientific Results of the Expedition to the Eastern Tropical Pacific... in the 'Albatross'." Part XVI. The Medusæ, Memoirs Mus. Comp. Zool., Harvard College, vol. 37, 243 pp., 48 pls.

—— 1913. "Medusæ and Siphonophoræ collected by the 'Albatross' in the North-western Pacific, 1906." Proc. U.S. Nat. Mus., vol. 44, pp. 1—119, pls. 1—6. Smithsonian Instit., Washington.

Broch, H., 1913. "Scyphomedusæ" in Report, Scientific Results of the "Michael Sars," North Atlantic Deep Sea Expedition, 1910. Vol. 3, part I. (Zool.), 23 pp., 1 pl. Bergen.

Brooks, W. K., 1886. "The Life-History of the Hydromedusæ." Mem. Boston Nat. Hist. Soc., vol. 3, pp. 359—430, pls. 37—44.

Brooks, W. K. and S. Rittenhouse, 1907. "On Turritopsis nutricula (McCrady)." Proc. Boston Nat. Hist. Soc., vol. 33, pp. 429—460, pls. 30—35.

Browne, E. T., 1904. "Hydromedusæ with a Revision of the Williadæ and Petasidæ." Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 2, pp. 722—749, pls. 54—57. Cambridge.

—— 1905. "Scyphomedusæ." Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 2, suppl. I., pp. 958—971, 1 pl. Cambridge.

—— 1905. "Medusæ," in Herdman's Pearl-Oyster Fisheries, Ceylon. Part IV., pp. 131—166, 4 pls. Royal Soc. London.

—— 1906. Biscayan Plankton collected during a Cruise of H.M.S. "Research," 1900. Part X. "The Medusae." Trans. Linn. Soc. London, vol. 10, pp. 163—185, pl. 13.

—— 1910. National Antarctic Expedition, "Discovery." "Medusæ." Vol. V., Part V., 62 pp., 7 pls. British Museum, London.

Eschscholtz, F., 1829. System der Acalephen. Berlin.

Fewkes, J. W., 1881. "Studies of the Jelly-fishes of Narraganseett Bay." Bull. Mus. Comp. Zool., Harvard College, vol. 8, pp. 141—176, pls. 1—10.

Gegenbaur, C., 1856. "Versuch eines Systemes der Medusen." Zeitschr. wiss. Zool., Bd. 8, pp. 202—273, Taf. 7—10.

Haeckel, E., 1865. "Die Familie der Russellquallen (Geryonida)." 194 pp., 6 Taf. Leipzig. (Abdruck. Jenaische Zeitschr. natw. Bd. 1—2.)

—— 1879—1880. Das System der Medusen. Jena.

Hartlaub, C., 1907. "Craspedote Medusen. Codoniden und Cladonemiden." Nordisches Plankton XII., 135 pp., 126 figs.

—— 1909. "Über einige von Ch. Gravier in Djibuti gesammelte Medusen." Zool. Jahrb. Jena. Bd. 27, pp. 447—476, Taf. 19—23.

HARTLAUB, C., 1914. "Craspedote Medusen. Tiaridæ." Nordisches Plankton XII., pp. 237—363.

HUXLEY, T. H., 1877. A Manual of the Anatomy of Invertebrated Animals. London.

KISHINOUYE, K., 1910. "Some Medusæ of Japanese Waters." Journ. Coll. Sci. Tokyo, vol. 27, Art. 9, 35 pp., 5 pls.

LO BIANCO, S., 1904. "Pelagische Tiefseefischerei der 'Maja' in der Umgebung von Capri." Bd. 1, 91 pp., 42 Taf. Jena.

MAAS, O., 1893. "Die Craspedoten Medusen." Ergebnisse der Plankton-Expedition "National." Bd. II, K.C., 107 pp., 8 Taf.

—— 1897. "Reports on an Exploration off the West coast of Mexico, Central and South America, and off the Galapagos Islands." "Albatross," 1891, XXI. "Die Medusen," Memoirs Mus. Comp. Zool., Harvard College, vol. 23, pp. 1—92, 15 Taf.

—— 1905. "Die Craspedoten Medusen der Siboga-Expedition." Monograph X, 84 pp., 14 Taf. Leyden.

—— 1906. "Méduses d'Amboine." Rev. Suisse Zool. Genève, Tom. 14, pp. 81—107, pls. 2—3.

—— 1909. "Beiträge zur Naturgeschichte Ostasiens. Herausgegeben von Dr F. Döflein. No. 8. Japanische Medusen." Abh. Akad. Wiss. München. Suppl. Bd. 1, pp. 1—52, 3 Taf.

MCCRADY, J., 1857. "Description of *Oceania* (*Turritopsis*) *nutricula* nov. spec., and the embryological history of a singular Medusan Larva, found in the Cavity of its Bell." Proc. Elliott Soc., vol. 1, pp. 55—90, pls. 4—7.

—— 1858. "Gymnopthalmata of Charleston Harbour." Proc. Elliott Soc., vol. 1, pp. 103—221, pls. 8—12.

MAYER, A. G., 1910. Medusæ of the World. 3 vols, 4to. Washington.

METSCHNIKOFF, E., 1886. Medusologische Mitteilungen. Wien. Arb. Zool. Instit. Univ. Bd. 6, pp. 237—266, Taf. 1—2.

MÜLLER, H., 1908. "Untersuchungen über Eibildung bei Cladonemiden und Codoniden." Zs. wiss. Zool., Leipzig. Bd. 89, pp. 28—80, Taf. 3—5.

VANHÖFFEN, E., 1902. "Die craspedoten Medusen der deutschen Tiefsee-Expedition, 'Valdivia,' 1898—1899." Wissen. Ergebnisse, Bd. 3, pp. 53—86, Taf. 9—12.

—— 1911. "Die Anthomedusen und Leptomedusen der Deutschen Tiefsee-Expedition, 'Valdivia,' 1898—1899." Bd. 19, pp. 193—233, Taf. 22.

—— 1912. "Die craspedoten Medusen des 'Vettor Pisani'." Zoologica, Heft 67, 33 pp., 2 Taf.

—— 1912. "Die craspedoten Medusen der deutschen 'Sudpolar' Expedition, 1901—1903." Bd. 13, Zool. V, pp. 353—395, Taf. 24—25.

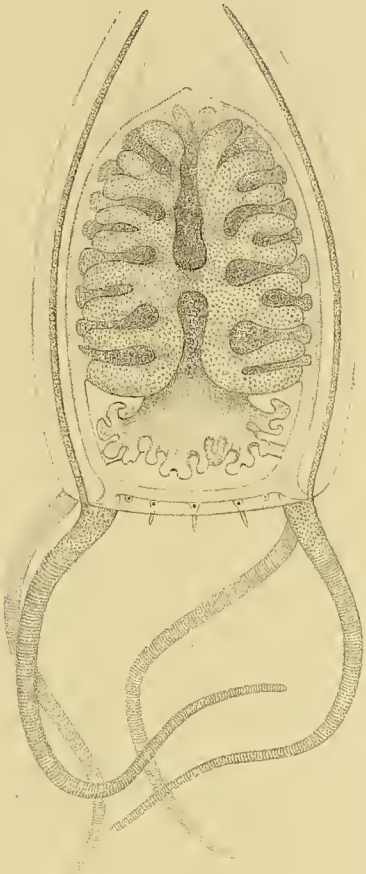
DESCRIPTION OF PLATE 39.

Fig. 1. *Steenstrupia normani*, n. sp. × 25.

Fig. 2. *Zanclea orientalis*, n. sp. × 25.

Fig. 3. *Zanclea orientalis*. A perradial rudimentary bulb (B) with a patch of nematocysts (N) on the margin of the ex-umbrella (Ex.). Circular Canal (CC). Velum (V).

Fig. 4. *Leuckartiara gardineri*, n. sp. × 12.



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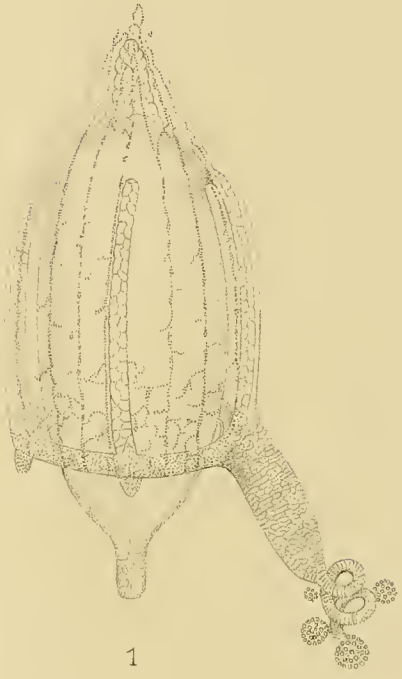

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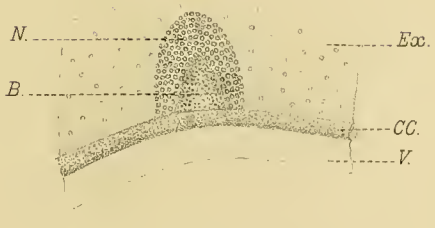

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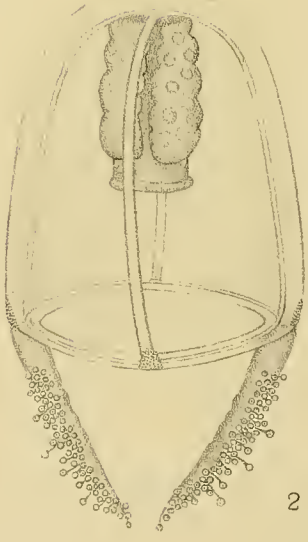


2

No. V.—REPORT ON THE HEXACTINELLID SPONGES (TRIAXONIDA) COLLECTED BY H.M.S. "SEALARK" IN THE INDIAN OCEAN.

By Arthur Dendy, D.Sc., F.R.S., F.L.S., *Professor of Zoology in the University of London (King's College).*

(Plates **40—43.**)

Read 17th June, 1915.

The "Sealark" collection contains only three species of Hexactinellid Sponges, but these are all extremely interesting forms, and I venture to hope that the somewhat detailed study that I have been able to make of them may add materially to our knowledge of this remarkable group.

Aulocalyx serialis is a new species of a genus hitherto known only by fragments of the type species (*A. irregularis*) obtained by the "Challenger" expedition and described by Schulze.

Heterorete pulchra is the type species of a new genus related to Dactylocalyx, and remarkable for the entire absence of special dermal and subdermal spicules. Fortunately the material of this species was much better preserved than is usually the case with hexactinellids, so that I am able to give some particulars as to the soft tissues and canal system. This sponge is further interesting on account of the presence in it of a commensal or parasitic hydroid ramifying through the substance of the wall, as well as of numerous Anthozoa attached to the surface.

Sarostegia oculata is a very beautiful and remarkable sponge, first described by Topsent from deep water off the Cape Verde Islands.

The preparation of this Report has been greatly facilitated by a grant from the Trustees of the Percy Sladen Memorial Fund to enable me to pay an assistant. I desire to express my thanks to the Trustees for their generous action, and I wish also to express my indebtedness to Miss Hilda Lucy Deakin, the assistant appointed, by whom most of the microscopical preparations and drawings of skeletal structures have been made, for the skill and care with which she has carried out the work entrusted to her.

The drawings of external forms were made for me by Mr T. P. Collings.

Genus Aulocalyx Schulze [1887].

This genus was founded by F. E. Schulze in 1887 for the reception of several fragmentary specimens obtained by H.M.S. "Challenger" from a depth of 310 fathoms off Marion Island, south-east of the Cape of Good Hope, and between Marion Is. and the Crozets at a depth of 1600 fathoms, and thus practically within the area of the Indian

Ocean. To these specimens the specific name *irregularis* was assigned. Schulze's diagnosis of the genus [1887, p. 380] is as follows:—"A thin-walled cup, much folded, extended into lateral diverticula, and also continued into short laterally projecting tubes. The cup is fixed by a firm irregular base. The connected framework of beams consists of much curved hexacts, partly united by synapticula, partly soldered together. The parenchyma contains loose discohexasters with short or with medium-sized principal rays, bearing S-shaped terminals disposed in perianth-like fashion. Under the skin there are large hexasters in which each of the short principal rays bears six long diverging terminals, which gradually increase in thickness towards the round outer end, and are beset all round with backward bent pointed hooks. The dermalia and gastralia are rough medium-sized oxypentacts."

Schulze placed his new genus in the family Rossellidæ of the then still accepted sub-order Lyssacina. I am not aware that the genus has again been met with excepting by the "Sealark" expedition in the Indian Ocean; but in his report on the Hexactinellida of the Valdivia (p. 180) Schulze [1904] accepts a new arrangement proposed by Ijima [1903], in accordance with which it is placed in the latter's new family Dactylocalycidæ, all the other genera of which are more or less typical dictyonine forms.

1. *Aulocalyx serialis* n. sp.

(Plate **40**, figs. 1—10 *a*.)

The largest and most perfect specimen (R.N. v. 1) has the form of a narrow, obconical goblet, terminating above in a slightly contracted mouth without any sieve-plate (cf. fig. 1). The wall of the goblet is longitudinally folded, and the prominent ridges on the outer surface appear to be made up each of a single row of short tubes fused together. The principal rows of tubes extend longitudinally from the constricted base of the sponge to the margin of the mouth; as they extend upwards the intervals between adjacent rows become wider and new rows appear between them. The tubes have conspicuous external openings and lead right through the wall of the goblet into the central cavity. Their internal openings lie in the bottom of longitudinal depressions of the inner surface. Altogether there are some eight or nine rows of these tubular openings in the wall of the sponge. In this specimen, unfortunately, the base of attachment has been broken off; but two other specimens (R.N. v. 2 and R.N. lxxxi.), which are in other respects much less perfect, show how the body of the sponge gradually contracts below and then expands into a small flattened disc of attachment (cf. fig. 1). The central cavity of the sponge is continued downwards practically as far as the basal disc, and there is no distinct stalk. The sponge is very fragile, the greater part of the body soft and compressible, almost woolly, but gradually becoming much more rigid below, owing to the stronger development of the dictyonal framework. All the soft tissues seem to have disappeared, and the best specimen (R.N. v. 1) contains a considerable quantity of fine white sand, consisting largely of foraminiferan and radiolarian skeletons. The height of the largest specimen, without the basal disc, is about 70 mm., and the greatest width, close to the top of the goblet, 29 mm.

The skeletal framework (fig. 2) consists of a very lax reticulation of large, smooth hexacts, with very long, slightly curving rays soldered together and joined by synapticula in a most irregular, but often ladder-like, fashion. A characteristic feature of this framework is that it sends out free ends, which project into the gastral cavity in the form of large hooks with very varying degrees of curvature (fig. 3).

The following kinds of separate spicules occur in the sponge :—

(1) Large and small parenchymal hexacts, having straight, slender rays with slightly roughened ends (figs. 4, 5).

(2) Large dermal and gastral pentacts; rays slightly roughened at the ends (fig. 6).

(3) Occasional small pentacts, with knob-like vestige of the sixth ray; rays slightly roughened (fig. 7).

(4) Discohexasters, varying somewhat as regards the curvature and arrangement of the terminal rays, which end in small discs with toothed margins (figs. 8, 9).

(5) Large hexasters with terminal rays ending in small knobs, and provided with rather long, backwardly pointing spines, the most distal of which may arise in a whorl from the terminal knob. These spines are very easily broken off, and this has evidently been the case to a large extent in the specimen figured (fig. 10). It is very difficult to find a specimen of this spicule perfect enough to draw, though a fair number of them occur in my preparations.

The only other species of Aulocalyx hitherto described is Schulze's *A. irregularis*, the type of the genus. To judge from the description and figures given in the "Challenger" report the chief difference between the two lies in the external form. In the "Challenger" species "the general form was that of a broadly expanded cup with complex, much folded or diverticulated wall." The generic diagnosis mentions the occurrence of "short laterally projecting tubes." These are not mentioned in the specific description but the general form is compared to that of *Periphragella elisæ*, the figure of which (Pl. LXXX) shows numerous short tubular projections, with open mouths, scattered irregularly over the outer surface of the cup. Schulze's general figure of the external form of *A. irregularis* (Pl. LX, fig. 1) does not show any distinct lateral tubes, but the specimen was evidently much injured. He gives a separate figure (fig. 2), however, of the macerated skeleton of a lateral tube, which seems to show that these structures are of the same nature as the tubular openings in *A. serialis*. There is no indication, however, that they are arranged in longitudinal rows as in the latter species, and the form of the cup in the two cases appears to be quite different, being very much narrower in *A. serialis*.

Another difference is found in the shape and size of the large, spiny-rayed hexasters or rosettes. Those of *A. serialis* are only about 0·24 mm. in diameter, while those of *A. irregularis* measure about 0·4 mm. Moreover, in the latter the ends of the long terminal rays are "simply convex, or more rarely somewhat knobbed," while in *A. serialis* they are, usually at any rate, distinctly knobbed, with a terminal whorl of backwardly pointing spines coming off from the knob as shown in fig. 10 *a*.

How far the differences between the two forms can be regarded as really specific

cannot be decided in the absence of better preserved specimens of *A. irregularis*. The two are evidently closely related and the localities from which they were obtained suggest that intermediate forms may occur at great depths in the intervening area of the Indian Ocean.

Register Nos., Localities, &c. v. 2, 4 (fragment), Saya de Malha, 7.9.1905, C. 20, 3—500 fathoms; LXXXI., Saya de Malha, 8.9.1905, C. 21, 450 fathoms.

Genus HETERORETE* n. gen.

The sponge consists of thick-walled, branching, cylindrical tubes, of stony hardness. The main skeleton is a stout dictyonal framework with very irregular meshes, in which slender-rayed hexacts gradually become incorporated by fusion, especially in the inner part of the tube-wall, where the stout dictyonal framework gives place to a much finer network formed by union of the slender-rayed hexacts. The nodes of the reticulation are not provided with spiny warts or with lychnisks. There are no uncinates, no scopulæ nor clavulæ, and no pentacts. There are discohexasters scattered in the parenchyma, especially in the inner portion of the wall. The canal system is complicated by strong folding of the chamber-layer and the flagellate chambers are comparatively small, oval or thimble-shaped.

This genus evidently falls into Ijima's family Dactylocalycidæ. It perhaps comes nearest to Dactylocalyx itself, but is remarkable for the complete absence of pentacts and, indeed, of special dermal or subdermal spicules of any kind.

2. *Heterorete pulchra* n. sp.

(Plate **41**, figs. 11—18.)

This species is represented in the collection by one good-sized fragment and a few small pieces evidently belonging to the same specimen. The sponge consists of irregularly branching tubes (fig. 11), about 8 mm. in diameter, and with walls about 2 mm. in thickness, so that there is a wide lumen of about 4 mm. diameter. There is some evidence of anastomosis between adjacent tubes, but this cannot be regarded as definitely established. Both inner and outer surfaces of the tubes are marked with numerous small, thickly-scattered pits, representing the openings of the exhalant and inhalant canals. The texture is rigid and stony, but brittle; the colour in spirit (with the soft tissues preserved) is opaque yellowish white, in the macerated condition it is glassy and transparent. Numerous minute Anthozoa (? Zoanthids) are attached to the outer surface of the tubes, but at wide intervals and apparently without any connection with one another. Apparently they have no effect on the growth of the sponge, which does not seem to respond in any way to their presence.

The main skeleton (figs. 12, 17) is a stout dictyonal framework of cylindrical trabeculæ, with irregular meshes. The bars are somewhat stouter and the meshes smaller at the dermal surface, where also short, conical processes are given off from the trabeculæ towards the dermal membrane, which they help to support. The whole of the dictyonal framework

* This name is proposed in allusion to the two kinds of skeletal net-work.

thus constituted is roughened with small conical spines, but these are more strongly developed on the subdermal trabeculæ than deeper down.

At various points rather small, spiny-rayed hexacts are seen to be undergoing incorporation in the general framework by fusion of their rays with the trabeculæ. To what degree the framework really grows by this incorporation of originally separate hexacts it is impossible to say, but the following observations rather suggest that it extends centripetally in this manner.

For some little distance beneath the gastral surface, in the region occupied by the inner trabecular layer of soft tissues, the main dictyonal framework is absent and its place is taken by scattered hexacts quite irregularly arranged. These hexacts (figs. 12, 17, *hex.*) are far more numerous here than anywhere else in the sponge, and it is at the junction of this layer with the chamber-bearing layer that the incorporation of hexacts in the dictyonal framework is chiefly seen (figs. 12, 18).

Possibly growth of the main skeleton also takes place by the formation and subsequent fusion of outgrowths from the trabeculæ themselves, as in *Sarostegia oculata*, but it is often difficult to distinguish between such outgrowths and the projecting rays of partially incorporated hexacts.

The hexacts of the subgastral layer also frequently unite with one another by fusion of rays, and thus tend to form a very irregular dictyonal framework with much smaller meshes and more slender trabeculæ than those of the main skeleton (fig. 12, *hex.*).

Sometimes even discohexasters may be incorporated in the skeletal framework, giving rise to very curious appearances (fig. 13).

The parenchymal spicules are as follows :—

(1) Spiny-rayed hexacts (figs. 12, *hex.*, 14); with rays straight or slightly curved, and varying a good deal in length and thickness; sometimes sharply pointed at the ends and sometimes more or less clubbed. These spicules occur chiefly in the subgastral layer, where they are united together by fusion of rays into an irregular, loose network, while the outer ones are also united in the same manner with the inner portion of the main dictyonal framework. It is difficult to find a single hexact lying entirely free in the parenchyma.

(2) Oxyhexasters (fig. 15); with long, slender, sharp-pointed rays. These appear to be extremely rare and are perhaps not a normal constituent of the spiculation.

(3) Discohexasters (fig. 16); with slender, curved rays terminating in toothed discs and varying much in length in different specimens. There are usually about five terminal rays to each principal. These spicules are very abundant in the subgastral portion of the sponge wall. Occasionally they become incorporated in the skeletal framework (fig. 13).

This sponge is sufficiently well preserved to enable me to give some account of the structure of the soft parts (figs. 17, 18). A very delicate dermal membrane (*d.m.*) is stretched over the outer surface of the main skeletal framework. This framework is interrupted at frequent intervals by the rather wide inhalant canals (*i.c.*). The dermal membrane still extends over the outer ends of these canals in some cases as a thin net pierced by the inhalant pores, but for the most part it is absent from the openings in question, perhaps owing to abrasion or shrinkage. Beneath the dermal membrane comes

a very thin external trabecular layer (*o.t.l.*), followed immediately by the chamber layer, which occupies by far the greater part of the thickness of the sponge wall. Then, on the inside of the chamber layer, comes a fairly thick subgastral or inner trabecular layer (*i.t.l.*), bounded internally by a thin gastral membrane (*g.m.*).

The wide inhalant canals run inwards approximately at right angles from the dermal surface and extend throughout the greater part of the thickness of the sponge wall. They branch more or less and interdigitate with similar exhalant canals, also branched and also extending through the greater part of the thickness of the wall, which open by wide apertures on the gastral surface (whether the gastral membrane ever extends over these apertures as a delicate net I am unable to say definitely, but I think it highly probable that it sometimes does). Owing to the obliquity and irregularity of their direction a transverse section of the sponge wall (fig. 17) shows the inhalant and exhalant canals sometimes cut across and sometimes cut lengthwise.

The flagellate chambers (*f.c.*) are very small for a hexactinellid sponge, only just about as large as those of a typical Leucandra, such as *L. phillipensis* [Dendy 1893], and much smaller than those of *L. australiensis* [Dendy 1893]. Indeed the whole canal system very closely resembles that of a Leucandra, except that the trabecular layers are represented in the latter by more continuous mesoglœal tissue. The large exhalant and inhalant canals may be regarded as formed by folding of the chamber-bearing layer, and it is probable that in reality there is only a single, much folded layer of chambers. Such appears to be the case at any rate in many places (*e.g.* in part of the section represented in fig. 17), but usually the arrangement has become greatly confused.

The chambers come close up to the surfaces of both inhalant and exhalant canals, but the actual surface in both is probably formed by a very thin, net-like trabecular layer. Most of the chambers communicate with the large exhalant canals, but some of them open into the irregular spaces in the subgastral trabecular layer (fig. 18).

The chambers themselves (figs. 17, 18, *f.c.*) are oval or thimble-shaped. I have measured them up to 0·2 mm. in length, but usually they appear a good deal shorter than this. The collared cells are very small and indistinct and it is impossible to make out any satisfactory histological details. Such histology as I have been able to observe is represented in fig. 18.

In addition to the numerous small Anthozoa attached to the outer surface, the sponge wall is penetrated in various directions by the branching stolons of a hydroid colony. The hydranths (fig. 17, *hyd.*) are elongatedly club-shaped, with few tentacles (two or three?) arranged in a single whorl springing from a short distance beneath the mouth. They are only sparsely scattered at long intervals on the hydrorhiza and appear to be capable of protrusion sometimes from the outer and sometimes from the inner surface of the sponge wall, though all now in a state of complete retraction. There is no distinct horny perisarc, though sometimes a very thin layer can be discerned which may represent the last vestige of such a structure. The hydranths occupy definite tubular cavities which run inwards from the surface of the sponge and appear to be lined by a continuation of the dermal or gastral membrane as the case may be. This hydroid is probably closely related to *Amphibrachium euplectellæ*, described by Schulze [1880] as occurring in the soft tissues of

Euplectella aspergillum. The latter species, however, has only two tentacles to each hydranth, while our form certainly seems to have at least three in some cases. Moreover the tentacles in Schulze's species are much longer than in ours, assuming both to be retracted to approximately the same extent. Schulze also speaks of a delicate, annulated perisarc tube in his species.

It seems probable therefore that the commensal hydroid of Heterorete belongs to a distinct species from that of Euplectella and, provisionally at any rate, it may be named *Amphibrachium infestans*.

Register No. and Locality. CXV., Salomon, 3.7.1905, C. 120—150 fathoms.

Genus Sarostegia Topsent [1904].

The sponge forms a coral-like colony of stony hardness, the more or less cylindrical, tubular or solid branches ramifying chiefly in one plane and sometimes anastomosing. The rather close dictyonal framework of the skeleton is made up of stout trabeculæ. The separate spicules consist of (1) dermal and gastral hexacts, in which one ray is frequently more or less completely reduced, (2) spinose hexacts, which tend to become incorporated with the dictyonal framework, (3) dermal sarulæ, (4) uncinates, (5) oxyhexasters, (6) discohexasters.

This well-characterised genus was founded by Topsent in 1904 for a remarkable sponge obtained by the "Princess Alice" and the "Talisman" in deep water off the Cape Verde Islands, and named *Sarostegia oculata*.

In the same year Schulze [1904] proposed the genus Ramella for fragments of a similar sponge collected by the "Valdivia" expedition near the Cape Verde Islands and Sumatra respectively. There can be little doubt that the specimen from the Cape Verde Islands at least is both generically and specifically identical with Topsent's.

Curiously enough, in the same year again, H. V. Wilson [1904, p. 84] proposed a genus, Sclerothamnopsis, for some fragments collected by the "Albatross" expedition in the Eastern Pacific, which may very well be generically identical with Topsent's and Schulze's specimens. In neither of these two latter cases, however, was the material sufficiently well preserved to afford the basis of a satisfactory generic diagnosis. In the "Valdivia" material the only separate spicules found were the uncinates. In the "Albatross" fragments the following are described, although in the generic diagnosis it is stated that the free spicules are not known with certainty :—

(1) Spinose hexacts (similar spicules occur in the "Sealark" material).

(2) Slender, smooth oxydiacts, always broken (probably broken uncinates, which, in the "Sealark" material, may have the spines very feebly developed, so that they resemble smooth oxydiacts).

(3) Oxyhexasters (similar spicules occur in the "Sealark" material).

(4) Pinnules of peculiar form, with the distal ray enormously swollen and beset with very short spines. Wilson remarks that these pinnules are very few in number but so peculiar that it seems likely that they belong to the sponge. On the other hand, in the

same work he figures practically identical pinnules for *Eurete erectum*, and I am strongly inclined to the opinion that they occur only as foreign bodies in Sclerothamnopsis.

(5) Scopulæ, few in number and also very likely foreign.

Neither pinnules nor scopulæ occur in the specimens of Sarostegia examined by Topsent and myself, but, in place thereof, the peculiar dermal spicules which Topsent termed "sarules" and which I propose to call "sarulæ."

On the whole there seems to be a strong probability that Wilson's Sclerothamnopsis is generically identical with Topsent's Sarostegia and Schulze's Ramella. If so, the genus is a very widely distributed one, occurring in the Atlantic, the Pacific and the Indian Oceans.

Under these circumstances the question of priority naturally arises, and we have to determine whether the genus is to be known as Sarostegia, Ramella or Sclerothamnopsis.

The date of publication of Topsent's paper is May 1904, that of Wilson's July 1904. Schulze's report on the "Valdivia" Hexactinellids is marked "Eingegangen den 16 Dezember 1903," but it was not published till some time in 1904; I have been unable to obtain further information as to the exact date.

Clearly Sclerothamnopsis may be eliminated, unless it should prove necessary to retain it on account of some generic peculiarity of the "Albatross" specimens, which seems improbable. As between the other two names I choose Sarostegia, on the ground that Schulze's genus Ramella, based upon very imperfect material, in which the characteristic spicules were entirely wanting, was quite insufficiently diagnosed.

Topsent placed *Sarostegia* in the family Farreidæ. This family was merged by Schulze [1904] in the Euretidæ, in which he also included his Ramella. The reason for the union of the two families was the breaking down of the distinction between "Scopularia" and "Clavularia" by the discovery of the genus Claviscopulia, described by Schulze in the "Amerikanische Hexactinelliden" [1899, p. 76 &c.]. *Claviscopulia intermedia*, the type species of the genus, in addition to clavulæ, possesses also spicules of a peculiar kind intermediate between clavulæ and scopulæ. These spicules, which Topsent terms "sarules," have the distal extremity club-shaped and beset with long spines, so that the whole comes to resemble somewhat a besom. It is very interesting to observe that sarules (or sarulæ) occur also in Sarostegia, although of a somewhat different form from those of Claviscopulia.

In his diagnosis of the family Euretidæ, Schulze [1904, p. 177] says that the coherent supporting framework is composed of dictyonal hexacts, which for the most part are united in a regular manner by the enclosure of the parallel apposed rays in layers of silica, so as to form a scaffolding with predominantly rectangular meshes. This is probably the primary arrangement of the framework in Sarostegia, but it is much obscured, at any rate in the "Sealark" specimen, by the formation of secondary trabeculæ subdividing the primary meshes into triangular areas.

3. *Sarostegia oculata* Topsent.

(Plates **42** and **43**, figs. 19—36.)

Sarostegia oculata Topsent [1904].
Ramella tubulosa Schulze [1904].
? Sclerothamnopsis compressa Wilson [1904].

Topsent's account of this beautiful species is not very detailed. The figures of external form are very fragmentary and only one kind of spicule, the sarula, is figured. It seems desirable, therefore, to give a complete account, with illustrations, of the "Sealark" material.

A large number of pieces were obtained, apparently in a single haul of the dredge, from a depth of 450 fathoms at Saya de Malha. It seems highly probable that they all formed part of a single specimen, which, owing to its brittle character, was broken into fragments in the dredge. The largest piece, drawn of the natural size in fig. 19, does not represent more than about one-sixth of the total material. Unfortunately the base is missing, but the sponge was doubtless attached in an erect position to a hard substratum by a somewhat expanded basal plate, as in the type. The branching is dichotomous (figs. 19 *a*, 19 *b*), and seems to have taken place mostly in one plane, though with occasional deviations into a plane even at right angles to the principal one. The branches are approximately circular in transverse section, there being no conspicuous flattening. The thickest branches measure about 10 mm. in diameter, while the most slender, terminal, branches may measure as little as 2 mm. Anastomosis of the branches appears to take place only occasionally.

The branches are partly tubular and partly solid. The tips may sometimes bear a small terminal opening, but at other times they appear to be solid, while considerable cavities may occur in the older portions. These cavities open to the exterior by very irregularly distributed oval apertures (figs. 19 *c*, 19 *d*, *ap.*) in the wall of the tube. They are sometimes occupied by polychæte worms, and I suspect it is the presence of these that keeps them open by preventing the ingrowth of tissues which takes place elsewhere. Certainly the solidification may take place while the branch is still very young. Topsent appears to regard the apertures in question as oscula, but I am very doubtful whether they can be correctly interpreted as such.

The surface of the sponge has a finely granulated character. The texture is hard but brittle, and the colour in alcohol and formalin is very pale brown*.

The whole of the surface of the sponge is more or less thickly studded with commensal or parasitic polyps (*pol.*), presumably zoanthids related to Palythoa. These are attached to the surface by expanded bases and can be picked off like scabs, leaving shallow depressions behind. It is extremely interesting to observe that the sponge responds to the presence of these polyps by enclosing each one in a delicate upgrowth of the dermal membrane, forming a thin translucent collar (figs. 19, 19 *f*, 19 *g*, *col.*), supported by the characteristic dermal spicules of the sponge, with a marginal fringe

* Topsent describes the sponge in life as being "semi-transparente, de teinte délicate, jaunâtre-rosée, émaillé d'Actinies commensales d'un orangé assez vif."

of sarulæ. These collars, however, are only preserved where the surface of the sponge has been protected from rubbing, as shown in fig. 19. In one case (fig. 19 *f*) two polyps, apparently formed by fission of a single one, were observed within the same collar. The polyps appear to be connected with one another by a network of stolons ramifying in the thickness of the sponge wall.

Similar polyps were described by Topsent in his specimen, and Schulze [1904] speaks of the macerated fragments obtained by the "Valdivia" as showing "dellenartige Oberflächenvertiefungen von ovaler oder doch rundlicher Form mit schwach erhabenem Rande." It seems probable that these are the shallow depressions left after the removal of the polyps. The association between sponge and polyp thus appears to be a constant one.

The main skeleton is a close framework of usually stout trabeculæ (up to about 0·07 mm. in thickness), with triangular meshes. As many as six bars of this framework may radiate from a common centre in approximately the same plane*, like the spokes of a wheel, connected at their outer ends by the spokes of similar adjacent systems, giving the whole framework a very characteristic appearance, as shown in fig. 33.

Apparently the whole framework grows not so much by incorporation of new hexacts as by the outgrowth of secondary trabeculæ, whose ends meet and fuse to form systems similar to those just described. This process is certainly responsible for the inward extension of the framework by which the original central cavity becomes more or less obliterated.

The structure of the dictyonal framework thus agrees very closely with Schulze's description and figure of *Ramella tubulosa*, except that what I may perhaps term the "rotulate" character, due to the formation of triangular meshes, appears to be more strongly pronounced (fig. 33). I have no doubt, however, that this character is a very variable one. In the older parts of the skeleton the trabeculæ are smooth, but in the younger parts, adjacent to the dermal and gastral surfaces, where the trabeculæ are more slender, they are often roughened with minute projections (fig. 34).

The manner in which the dictyonal framework spreads into the central cavity is well shown in figs. 35 and 36. Slender, more or less radially arranged outgrowths are given off from the superficial trabeculæ of the gastral surface (fig. 35, *pr.*), and their ends, coming in contact with one another, fuse to form a new node of the skeleton (fig. 36, *pr.*). Doubtless these slender processes, which are at first minutely roughened, are thickened and become smooth later on by the addition of concentric layers of silica. Growth seems to take place at the dermal surface of the dictyonal framework in precisely the same manner, and probably some, at any rate, of the freely projecting, minutely spiny knobs, which occur on this surface, are the immediate agents concerned therein. I have seen just the same fusion of such outgrowths to form a new node on the dermal as on the gastral surface. Some of the minutely spiny knobs on the dermal surface, however, appear to be the reduced centrifugal rays of the outermost fused hexacts of the original framework, as described by Topsent.

* Of course similar bars radiate from the same centre in other planes.

The dermal skeleton consists, in the first place, of stout hexacts (figs. 20, 21, 22), with the outwardly projecting ray much shortened and the inwardly projecting ray lengthened. The rays are bluntly rounded at their extremities and usually quite smooth, although a little roughening may sometimes be detected, especially towards the end of the longest ray, which may also be more sharply pointed (fig. 21).

Between the dermal hexacts occur numerous radially arranged sarulæ of the form shown in figs. 23, 24, 25. These remarkable spicules consist of a straight shaft, sometimes slightly roughened, and terminating at the inner end in a blunt point, while the outer end is oval club-shaped and covered with stout, sharp, forwardly-directed spines more or less fused together.

The dermal skeleton is evidently very easily rubbed off and is only well preserved in places, especially in the membranous collars surrounding the polyps, where, as already stated, the sarulæ form a marginal fringe.

The gastral skeleton consists of hexacts (figs. 26, 35, *hex.*) of the same general type as the dermal hexacts, but the rays are more slender, generally less unequal in length (though usually one still seems to be very short), and frequently knobbed at the extremities. In the invasion of the original central cavity by the skeleton these spicules become very irregularly arranged (fig. 35, *hex.*), but they may still be seen, crowded together in the middle of the sponge, even after the central cavity has been completely obliterated. They seem to retain their independence for a long time, but it is quite possible that they ultimately become incorporated in the dictyonal framework.

The parenchymal spicules are as follows:—

(1) Very long and slender uncinates, sharply pointed at the two extremities and with feebly developed teeth (fig. 32).

(2) Small spiny hexacts (fig. 27) lying between the trabeculæ of the dictyonal framework, with which their rays may become fused. (It is sometimes difficult to distinguish these from new nodes formed by outgrowth and fusion of spiny processes from the trabeculæ (cf. fig. 36, *pr.*).)

(3) Oxyhexasters (figs. 28, 29, 30). Very variable, with smooth, slender, sharp-pointed rays.

(4) Discohexasters (fig. 31). Rather compact, with not very long terminal rays, about five to each principal.

Although a good deal of the soft tissues of the sponge still remains, I have not been able to make out the flagellate chambers.

I do not think there can be any reasonable doubt that the "Sealark" specimen is specifically identical with Topsent's type from the Cape Verde Islands, in spite of the difference in locality. There do, it is true, appear to be some minor differences in spiculation, as indicated by Topsent's account of the dermal hexacts and pentacts, which, unfortunately, he does not figure, and by the absence of all mention by him of the spiny hexacts (No. 2 above). It is probable, however, that these apparent differences would disappear if it were possible to make a direct comparison of the specimens, and the agreement in other respects is so close that I feel justified in making an identification.

Previously known Distribution. Near Cape Verde Is. (Topsent and Schulze); Sumatra (Schulze); ? Eastern Pacific (Wilson).

Register Nos., Locality, &c. I., II., III., IV., IV*a*., Saya de Malha, 8.9.1905, C. 21, 450 fathoms.

LIST OF LITERATURE REFERRED TO.

1893. Dendy, A. "Studies on the Comparative Anatomy of Sponges, V. Observations on the Structure and Classification of the Calcarea Heterocœla." (Quart. Journ. Micro. Sci., vol. 35.)

1903. Ijima, I. "Studies on the Hexactinellida. Contribution III." (Journ. Coll. Sci. Imp. Univ. Tokyo, vol. 18.)

1880. Schulze, F. E. "On the Structure and Arrangement of the Soft Parts in *Euplectella aspergillum*." (Trans. Royal Soc. Edin., vol. 29.)

1887. Id. Report on the Hexactinellida of the "Challenger" Expedition.

1899. Id. "Amerikanische Hexactinelliden nach dem Materiale der 'Albatross'-Expedition."

1904. Id. Hexactinellida of the "Valdivia" Expedition.

1904. Topsent, E. "*Sarostegia oculata*. Hexactinellide nouvelle des îles du Cap-Vert." (Bull. Mus. Océanographique de Monaco, No. 10, 20 Mai 1904.)

1904. Wilson, H. V. Sponges of the "Albatross" Expedition of 1891.

DESCRIPTION OF PLATES.

Plate 40.

Figs. 1—10 *a*. *Aulocalyx serialis* n. sp.

Fig. 1. Restoration of entire sponge (based mainly on R.N. v. 1). × 2.
Fig. 2. Part of skeletal framework (R.N. v. 1). × 110.
Fig. 3. Part of skeletal framework ending in hooks which project into the gastral cavity (R.N. v. 1). × 110.
Fig. 4. Large parenchymal hexact (R.N. v. 1). × 100.
Fig. 5. Small parenchymal hexact (R.N. v. 1). × 320.
Fig. 6. Large pentact (R.N. v. 1). × 100.
Fig. 7. Small pentact with vestige of sixth ray (R.N. v. 1). × 320.
Figs. 8, 9. Discohexasters (R.N. v. 1). × 320.
Fig. 10. Characteristic large hexaster with spiny rays (R.N. v. 1). × 320.
Fig. 10 *a*. End of ray of large hexaster more highly magnified.

Plate 41.

Figs. 11—18. *Heterorete pulchra* n. gen. et sp.

Fig. 11. Part of a colony. × 2.
pol. parasitic or commensal Anthozoa.
Fig. 12. Part of dictyonal framework, as seen in transverse section, showing the transition to the layer of scattered and partially fused hexacts (*hex.*) in the inner portion of the sponge wall. × 100.
Fig. 13. Portion of skeletal framework from inner part of sponge wall, showing incorporation of discohexasters. × 360.
Fig. 14. Spiny-rayed hexact. × 540.
Fig. 15. Oxyhexaster. × 540.
Fig. 16. Discohexaster. × 540.
Fig. 17. Transverse section of sponge wall, showing soft tissues and canal system. (Combined drawing.) × 50.
d.m. dermal membrane; *e.c.* exhalant canal; *f.c.* flagellate chambers; *g.m.* gastral membrane; *hyd.* hydroid polyp; *i.c.* inhalant canal; *i.t.l.* inner (subgastral) trabecular layer; *o.t.l.* outer (subdermal) trabecular layer.
Fig. 18. Part of inner portion of a transverse section showing soft tissues, more highly magnified (Zeiss D. oc. 2).
disc. discohexaster; *hex.* hexacts. Other lettering as before.

Plate 42.

Figs. 19—31. *Sarostegia oculata* Topsent.

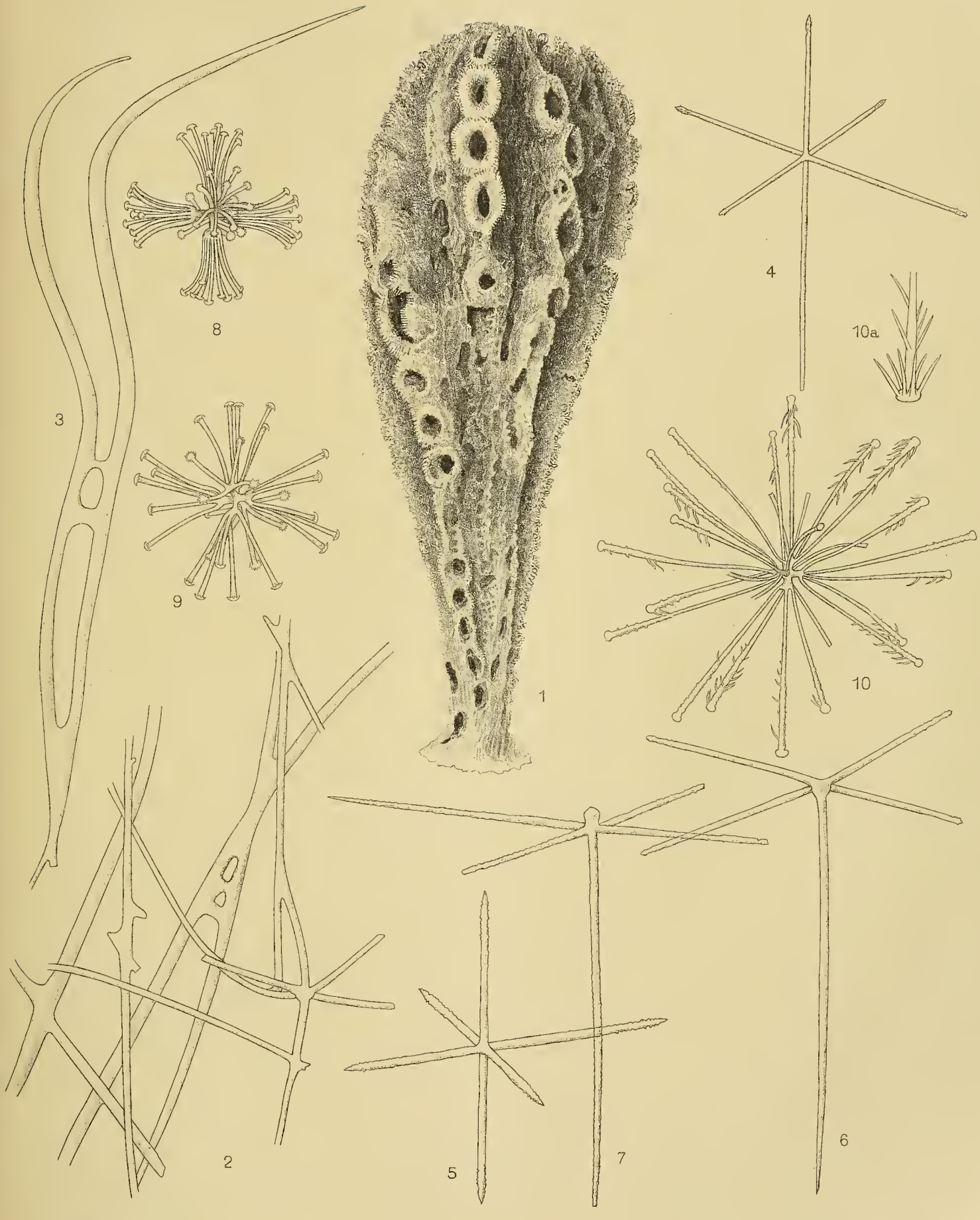
Fig. 19. The largest piece of the sponge. Nat. size.
col. collars of sponge tissue surrounding parasitic or commensal polyps (*pol.*).
Figs. 19 *a*, 19 *b*. Two other pieces, showing ends of branches. Nat. size.
Figs. 19 *c*, 19 *d*. Portions of two hollow branches showing apertures (*ap.*). Nat. size.

Fig. 19 *e*. A single polyp as it appears when removed from the sponge. × 3.
Fig. 19 *f*. Two polyps enclosed in the same collar (*col.*). × 3.
Fig. 19 *g*. Side view of collar (*col.*) enclosing polyp. × 3.
Figs. 20, 21, 22. Stout dermal hexacts, from collar around polyp. × 175.
Figs. 23, 24, 25. Sarulæ, from collar around polyp. × 175.
Fig. 26. Gastral hexact, from central cavity of skeletal framework. × 175.
Fig. 27. Spiny parenchymal hexact. × 175.
Figs. 28, 29, 30. Oxyhexasters. × 540.
Fig. 31. Discohexaster. × 540.

Plate 43.

Figs. 32—36. *Sarostegia oculata* Topsent.

Fig. 32. Uncinate. × 102.
Fig. 33. Part of dictyonal framework as seen in longitudinal section through end of branch. × 60.
Fig. 34. Part of dictyonal framework as seen in tangential section just below surface. × 175.
Fig. 35. Skeleton surrounding central cavity, as seen in transverse section near tip of young branch. × 60.
c.c. central cavity; *hex.* hexacts; *pr.* spiny processes of trabeculæ.
Fig. 36. Skeleton surrounding central cavity, as seen in transverse section, to show the union of spiny processes (*pr.*) to form a new node of the network. × 60.



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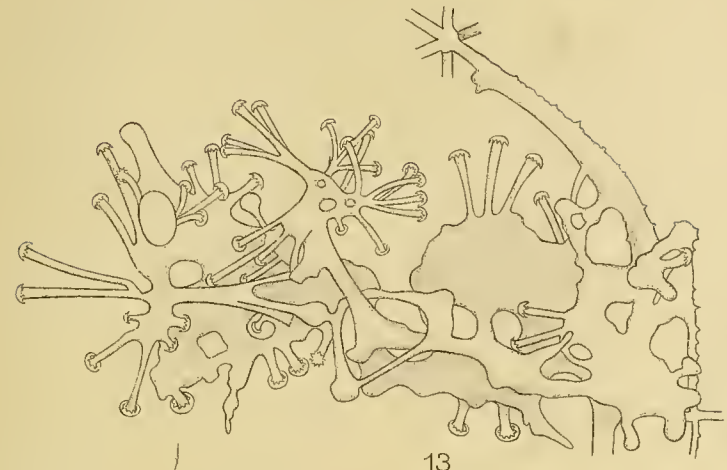
AULOCALYX SERIALIS n. sp.



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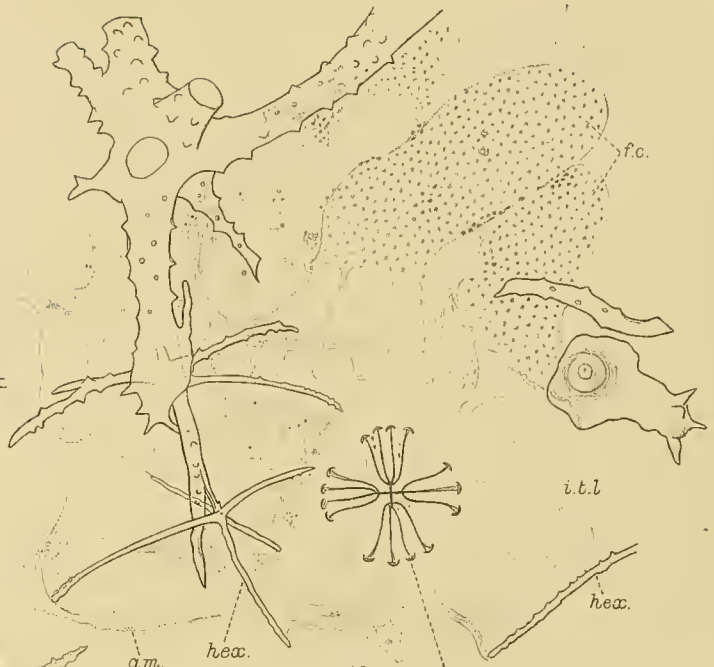

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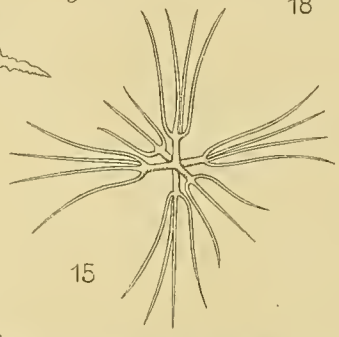

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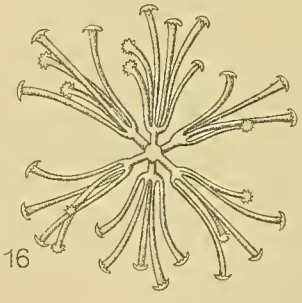

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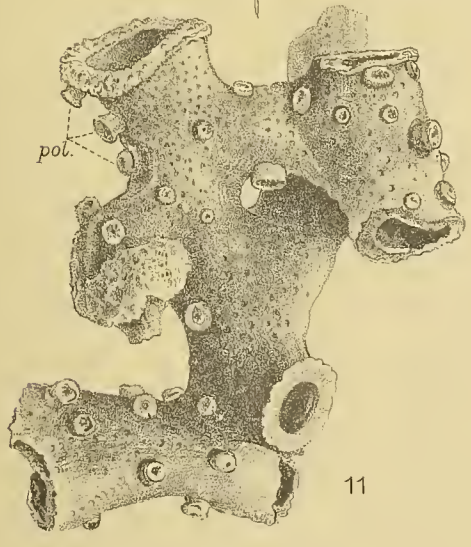

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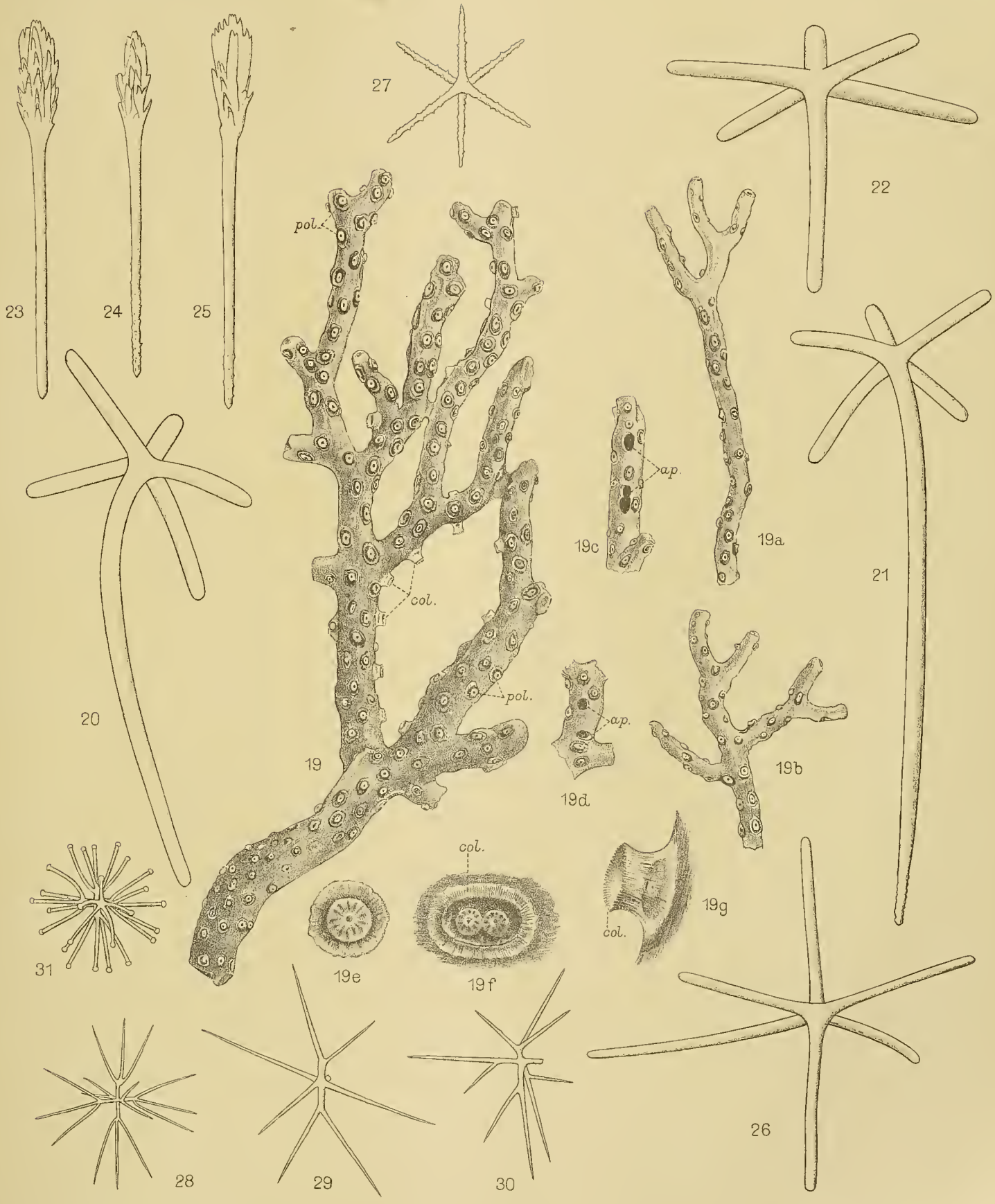
HETERORETE PULCHRA n.sp.



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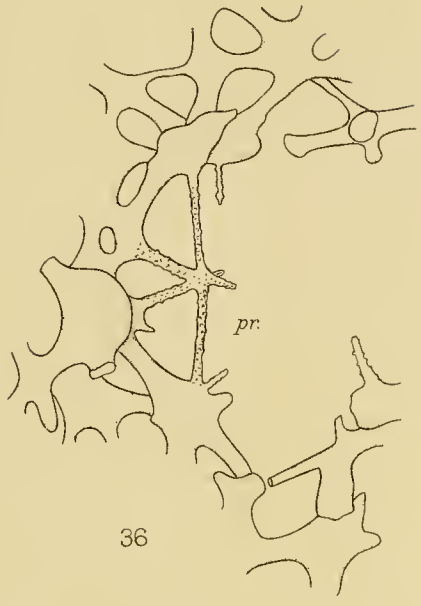
SAROSTEGIA OCULATA Topsent.



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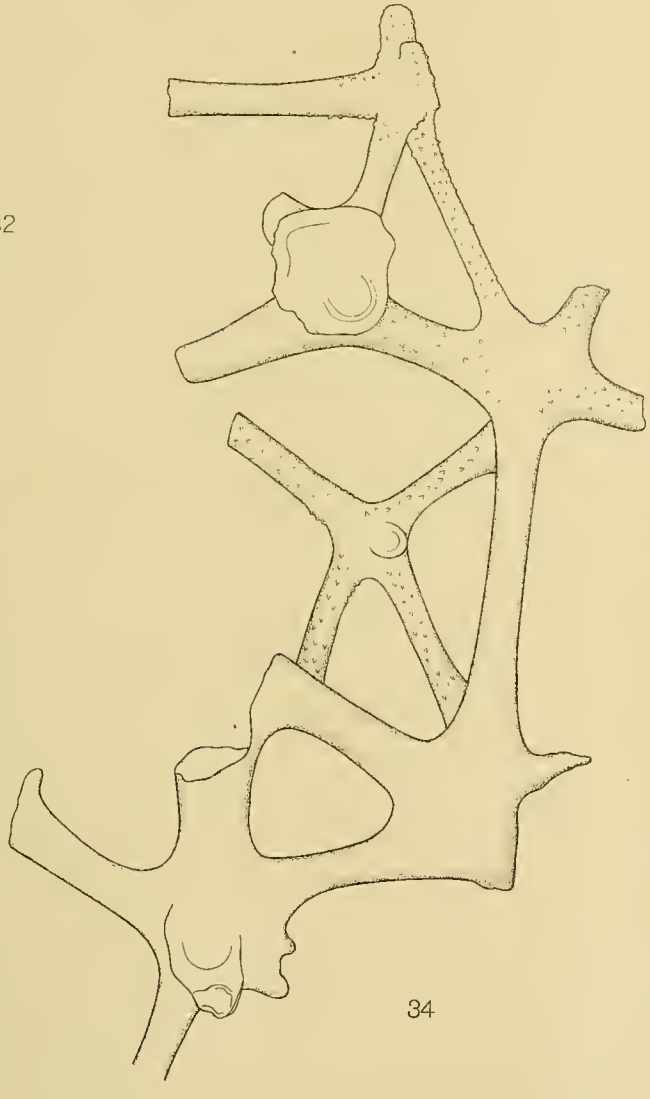

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SAROSTEGIA OCULATA. Topsent.

No. VI.—REPORT ON THE HOMOSCLEROPHORA AND ASTROTETRAXONIDA COLLECTED BY H.M.S. "SEALARK" IN THE INDIAN OCEAN.

By Arthur Dendy, D.Sc., F.R.S., F.L.S., *Professor of Zoology in the University of London (King's College).*

(Plates 44—48.)

Read 17th June, 1915.

The present instalment of my Report on the Sponges collected in the Indian Ocean by the "Sealark" expedition deals with a portion only of the Tetraxonida, viz. the Homosclerophora and Astrotetraxonida, leaving the Sigmatotetraxonida—a very large group—to be dealt with subsequently. It will be noticed that the families Spirastrellidæ and Latrunculiidæ, hitherto included by general consent in the Astrotetraxonida, are omitted from the present communication. The reason for this is that I have convinced myself—largely through investigation of the "Sealark" material—that the so-called asters of these two families are really pseudasters, and that the groups in question are of desmacidonid origin and must therefore be included amongst the Sigmatotetraxonida. I hope to discuss the question at length in a future instalment of my Report.

The classification of the Astrotetraxonida is as yet by no means in a satisfactory condition, but a comprehensive revision of the group will be necessary before attempting any radical reform. Such a revision I have already commenced in conjunction with my colleague Mr R. W. H. Row, but it would not be desirable to delay the publication of this report until it is completed, as it must necessarily take a long time. I may be allowed to state, however, that, although I retain the family Pachastrellidæ as a matter of convenience, I cannot regard that family, as generally understood, as constituting a natural group—it probably contains forms on the up-grade from the Homosclerophora to the Stellettidæ and others which are nothing but degenerate Stellettids. The latter appear to be analogous to the so-called "Epipolasidæ," but differing from these in that it is only the rhabdome of the triæne that has undergone reduction. The "Epipolasidæ" I no longer accept as a family, those which are present in the "Sealark" collection will be found amongst the Stellettidæ.

Twenty-five species are dealt with in the present contribution, of which nine appear to be new. The list is as follows :—

Order TETRAXONIDA.

Sub-order HOMOSCLEROPHORA.

Family **Plakinidæ.**

1. *Dercitopsis minor* n.sp.

Sub-order ASTROTETRAXONIDA.

Family **Pachastrellidæ.**

2. *Pachastrella tenuilaminaris* (Sollas).
3. *Yodomia perfecta* n.sp.

Family **Stellettidæ.**

4. *Myriastra parva* (Row).
5. *Myriastra cavernosa* n. sp.
6. *Dragmastra lactea* (Carter) var. *mauritiana* nov.
7. *Rhabdodragma* (n. gen.) *conulosa* (Kieschnick).
8. *Ecionemia carteri* Dendy.
9. *Ecionemia laviniensis* Dendy.
10. *Aurora providentiæ* n. sp.
11. *Aurora cribriporosa* n. sp.
12. *Aurora rowi* n. sp.
13. *Asteropus simplex* (Carter).
14. *Jaspis johnstonii* (Schmidt).

Family **Geodiidæ.**

15. *Geodia auroristella* n. sp.

Family **Erylidæ.**

16. *Erylus lendenfeldi* Sollas.
17. *Erylus proximus* n. sp.

Family **Donatiidæ.**

18. *Donatia lyncurium* auctorum.
19. *Donatia japonica* (Sollas).
20. *Donatia ingalli* (Bowerbank).
21. *Donatia seychellensis* (Wright).
22. *Donatia stella-grandis* n. sp.

Family **Chondrosiidæ.**

23. *Chondrilla australiensis* Carter.
24. *Chondrilla mixta* Schulze.
25. *Chondrilla sacciformis* Carter.

I am again indebted to the Trustees of the Percy Sladen Fund for financial assistance in the preparation of illustrations, &c., and to Miss Deakin for much valuable help rendered possible thereby, especially for her faithful and painstaking drawings of spicules.

I refrain from publishing a reference list of literature with the present instalment, as it will be quite sufficient to publish one list later on for the whole of the Tetraxonida. In the meantime the dates given after authors' names may afford sufficient clue to the memoirs referred to.

Order TETRAXONIDA Dendy [1905].

Sponges with siliceous spicules whose fundamental form is tetraxonid and tetractinellid. (This fundamental form is often obscured by secondary modifications, and the spicules may even disappear completely in some degenerate forms.)

In 1905 I proposed to arrange the order Tetraxonida as follows:—

Grade TETRACTINELLIDA.
Sub-order Homosclerophora.
„ Astrophora.
„ Sigmatophora.

Grade LITHISTIDA.

Grade MONAXONELLIDA.
Sub-order Astromonaxonellida.
„ Sigmatomonaxonellida.

The Sub-orders Astrophora and Sigmatophora were, of course, adopted from Sollas [1888] and the Homosclerophora replaced his Microsclerophora.

The Astromonaxonellida were regarded as being derived from the tetractinellid Astrophora and the Sigmatomonaxonellida from the tetractinellid Sigmatophora [Dendy, 1905, p. 133].

The views thus expressed as to the phylogeny of the Tetraxonida have been accepted by Hentschel [1909, 1911 A] in his work on the Tetraxonida of S.W. Australia. He has, however, proposed a modification of my arrangement which gives clearer expression to these views and which I gladly accept. He divides the order Tetraxonida directly into three sub-orders:—

Sub-order 1. Homosclerophora Dendy.
„ 2. Astrotetraxonida Hentschel (= Astrophora + Astromonaxonellida Dendy).
„ 3. Sigmatotetraxonida Hentschel (= Sigmatophora + Sigmatomonaxonellida Dendy).

We are thus, I hope, finally rid of the old artificial distinction between "Tetractinellida" and "Monaxonida," introduced by Zittel [1878 A], which the "Challenger" Reports unfortunately did so much to emphasise.

With regard to the Lithistida and Ceratosa Hentschel remains in some doubt, suggesting that they may have to be added as two separate sub-orders to the three above mentioned. This is possibly the best thing to do with the Lithistida in the present stage of our knowledge, though I should not like to commit myself to a definite

opinion as yet. With regard to the Ceratosa I adhere to the views I have already expressed [1905]. Only the "Pseudoceratosa" have any claim to be included in the Tetraxonida, and whether these can be constituted into a distinct sub-order is extremely doubtful. Some of them appear to me to be certainly Chalinine in origin, while others are very possibly Ectyonine.

Sub-order 1. Homosclerophora Dendy [1905].

Tetraxonida in which microscleres and megascleres have not yet become sharply differentiated from one another and no triænes are as yet developed.

I cannot agree with Hentschel in including [1909] the Oscarellidæ in this sub-order, which seems to me to be a distinctly retrograde step. I adhere to the opinion which I expressed in 1905, that Oscarella must be placed in a separate order, Myxospongida, which represents the common ancestors of all the siliceous sponges, both Triaxonida and Tetraxonida, and also of the Euceratosa.

Family **Plakinidæ**.

With the characters of the sub-order.

This family was proposed by Schulze in 1880 for the reception of the three genera Plakina, Plakortis and Plakinastrella. References to its history between 1880 and 1900 are given by Lendenfeld [1903, p. 118]. In addition to the three original genera Lendenfeld includes in the family Corticium and Thrombus. In 1905 I removed Plakinastrella from the Plakinidæ on account of the presence of short-shafted triænes, and placed it in the Pachastrellidæ, an arrangement to which I must adhere.

Genus Dercitopsis Dendy [1905].

Plakinidæ with calthrops, oxea and sometimes triods, but no candelabra. All spicules smooth.

When I proposed this genus in 1905 I unfortunately overlooked the existence of two species which must certainly be taken into account in discussing its affinities, viz. *Plakinastrella clathrata*, described by Kirkpatrick [1900 B] from Funafuti, and *P. oxeata*, described by Topsent [1904 A] from the Azores. More recently Lendenfeld [1906] has described a species under the name *Plakinastrella mammillaris*, from the west coast of Australia, which must also be considered in the same connection. That all these three species are closely related to my *Dercitopsis ceylonica* there can be no doubt, but I am not disposed to agree with Lendenfeld [1906] that *Dercitopsis ceylonica* should be associated with them in the genus Plakinastrella. On the contrary I think that all three should be removed from Plakinastrella and placed in Dercitopsis, and that for the following reasons.

The type species of Plakinastrella is *P. copiosa*, described and figured by Schulze [1880]. That species possesses well-differentiated, short-shafted triænes, definitely orientated beneath the surface of the sponge, and, as already stated, it was mainly for that reason that in 1905 I placed it in the Pachastrellidæ. Not one of the species placed

by Kirkpatrick, Topsent and Lendenfeld in the genus Plakinastrella possesses triænes, but, on the contrary, all of them belong to the Homosclerophora.

The genus to which *Dercitopsis* is most closely allied is not, in my opinion, Plakinastrella, but Plakortis [Schulze 1880]. Indeed it is perhaps not easy to separate the two satisfactorily, but Schulze, in his original diagnosis of the genus Plakortis, emphasised the fact that tetract spicules were wanting, only triacts and diacts being developed. We may take this as the basis of the generic distinction. Plakortis also seems to be more primitive than Dercitopsis as regards canal system, but in this respect the gap seems to be bridged over to some extent by *Dercitopsis clathrata* (Kirkpatrick).

The presence of radially arranged small oxea at the surface must be abandoned as part of the generic diagnosis of Dercitopsis, for, though such a layer is present in *D. ceylonica* Dendy, *D. clathrata* (Kirkpatrick) and *D. minor* n. sp., it is absent in *D. oxeata* (Topsent) and (apparently) in *D. mammillaris* (Lendenfeld). The last named species is remarkable in another respect, for the spiculation includes only oxea and calthrops, triods being completely absent.

1. *Dercitopsis minor* n. sp.

(Plate **44**, fig. 1; Plate **45**, fig. 1.)

The sponge (Plate **44**, fig. 1) forms irregular, rounded, cushion-like masses, encrusting pieces of rock, &c. The margins are broadly rounded and may project considerably beyond the base of attachment, and become tucked in, thus tending to envelope the support. The maximum dimensions of the largest specimen (R.N. XLII. 6) are as follows:—Length 78 mm., breadth 57 mm., thickness about 16 mm. The surface is smooth but rather uneven; subglabrous and minutely punctate. The colour of the surface (in spirit) varies from light brown to dark slate grey; internally it is pale yellowish. Vents of moderate size, up to about 3 mm. in diameter, each with a prominent, membranous collar; few in number and scattered singly on prominent portions of the upper surface. Inhalant pores closely scattered all over the surface. Texture firm and compact.

The skeleton is a dense feltwork of loose spicules, quite irregularly arranged except at the surface, where very small oxea are placed more or less at right angles to the surface to form a dermal layer.

Spicules:—(1) Calthrops (Plate **45**, fig. 1 *a*), with smooth, sharp-pointed rays measuring about 0·037 by 0·005 mm. in a well grown specimen, but varying a good deal.

(2) Triods (Plate **45**, fig. 1 *b*), differing from the calthrops in the absence of one ray. Perhaps, on an average, the rays of the triods are more slender than those of the calthrops, but slender-rayed forms of both occur.

(3) Oxea (Plate **45**, fig. 1 *c*), fusiform, slender, slightly curved, gradually sharp-pointed, almost always with a kink or enlargement in the middle. Size variable, averaging in the deeper parts of the sponge, say, about 0·1 by 0·004 mm., though often much more slender. The largest seen, and that only once, measured only about 0·19 mm. in length. The small dermal oxea measure up to about 0·04 mm. long and are of proportionate thickness. Intermediate sizes between these and the deeper oxea are abundant. The oxea are far more numerous than both triods and calthrops together.

The ectosome and the outer part of the choanosome contain numerous small, brown, granular pigment-cells. I have not examined the canal system in detail, but it appears to agree closely with that of *Dercitopsis ceylonica* [Dendy 1905].

Dercitopsis minor would appear to be a common species in the Indian Ocean. At first I thought it must be specifically identical with the Ceylon form, but the fact that the oxea never, in any of the specimens, seem to reach half the size that many of them attain in *D. ceylonica*, renders it, in my opinion, desirable to recognise a specific distinction.

The external appearance of the sponge strongly recalls that of a *Chondrilla*, with which genus it may readily be confounded until examined microscopically, especially when, as in the case of R.N. XXXIII. 1 A, the two are growing together.

Register Nos., Localities, &c. XXXIII. 1 A, XXXIII. 2, and XLIII. 3, Cargados Carajos, 30.8.05, B. 13, 30 fathoms; XLII. 6, Cargados Carajos, 30.8.05, B. 9, 30 fathoms; CII. 2 A (encrusting *Erylus lendenfeldi*), Amirante, 18.10.05, E. 25, 44—20 fathoms; CXI. 7 and CXIII. 12, Egmont Reef.

Sub-order 2. Astrotetraxonida Hentschel [1909].

Tetraxonida with astrose microscleres (except when these have been lost secondarily); without sigmata or their derivatives.

Family **Pachastrellidæ**.

Astrotetraxonida with calthrops and (or) short-shafted triænes, usually scattered irregularly in the interior of the sponge, though some of the short-shafted triænes may be definitely orientated, with the cladi supporting the ectosome. Without typical long-shafted triænes and without sterrasters.

As already stated, this family is only retained provisionally. It is probably of polyphyletic origin, containing both primitive forms and degenerate stellettids.

Genus Pachastrella Schmidt [1868].

Pachastrellidæ with oxea and calthrops and (or) short-shafted triænes for megascleres; without mesotriænes; with microrhabds and various forms of streptaster for microscleres, but without spherasters.

I must agree with Lendenfeld [1903] in merging Sollas's genus Pœcillastra, which I was at first strongly disposed to retain, in Pachastrella. There appears to be really nothing but the plate-like form and the distribution of pores and oscula to distinguish the two, and these characters vary so much that they cannot, at any rate in this case, be regarded as of generic import.

2. *Pachastrella tenuilaminaris* (Sollas).

(Plate **45**, fig. 2.)

Normania tenuilaminaris Sollas [1886].
Pœcillastra tenuilaminaris Sollas [1888].
Pachastrella crassiuscula Lendenfeld [1903].
Pachastrella tenuilaminaris Lebwohl [1914].

I identify with this species a plate-like fragment of considerable size, about 58 mm. in length, 45 mm. in breadth and 8 mm. in thickness. The plate is slightly curved and one surface bears small, thickly scattered pore-sieves, while the other bears numerous small, scattered oscula, less than 1 mm. in diameter and with their margins level with the general surface. The margin of the plate, where intact, is broadly rounded, but the incurrent face ends sharply above in a well-marked edge. Part of this edge only is provided with a fringe of long projecting oxea and both surfaces are also hispid in places.

The broken edges show the narrow inhalant and exhalant canals running through the plate more or less at right angles to the two surfaces.

The colour in spirit is dull, pale yellow; texture firm and harsh, but rather friable.

The skeleton is an extremely confused feltwork of large oxea. There are also numerous very long and very slender oxea which are chiefly arranged in loose fibres or wisps, which run towards the surface and in places project therefrom in long loose bundles. The comparatively few tetract spicules appear to be quite irregularly scattered through the sponge.

Spicules. (1) Calthrops and short-shafted triænes (Plate **45**, fig. 2 *a*), not sharply distinguishable from one another. Rays sharp-pointed or rounded, about 0·5 mm. long by 0·05 mm. in diameter at the base. The rays are sometimes slenderer. These spicules are not numerous and they rarely show any reduction of rays, but irregularly branched forms are occasionally found.

(2) Stout, fusiform, slightly curved and sharply pointed* oxea (fig. 2 *b*), measuring about 3·0 by 0·05 mm. Sometimes reduced, by rounding off of one or both ends, to styli or strongyla (figs. 2 *c*, 2 *d*). Shorter oxea also occur.

(3) Long, hair-like oxea (fig. 2 *e*), of about the same length as the largest but only about 0·008 mm. thick. Very numerous and commonly arranged in loose wisps.

(4) Slender-rayed metasters (fig. 2 *f*), with about six or eight long rays or spines. Greatest length of entire spicule usually about 0·016 mm.

(5) Microxea (fig. 2 *g*); slender, slightly curved, sharply pointed; with very slight indications of roughening; size about 0·15 by 0·004 mm. Rather scarce.

I have in my possession several of Sollas's original preparations of *Pachastrella* (*Pœcillastra*) *tenuilaminaris* and a careful comparison of these with the "Sealark" specimen seems to me to justify a specific identification. The chief apparent differences are as follows.

(1) The "Challenger" specimen had no special hispidating fringe at the margin. This is of little importance.

(2) The long hair-like oxea are not mentioned in Sollas's description. They are certainly very rare in the "Challenger" material, but I have seen a few.

(3) The tetract spicules are less numerous in the "Sealark" specimen; they show no tendency (so far as observed) to regular arrangement at the margin, as in the "Challenger" specimen.

(4) Reduced tetracts with only one ray are common in the "Challenger" material. I have never seen them in the "Sealark" specimen.

* Sollas's statement that the oxea are not sharply pointed is not borne out by his preparations.

(5) The metasters are decidedly smaller in the "Sealark" specimen and do not show so strong a tendency to pass into plesiasters.

(6) The microxea are much fewer in the "Sealark" specimen and the tendency to roughening of the surface is less pronounced, but it is very slight even in the "Challenger" specimen.

(7) The plate of which the sponge is composed is more than twice as thick in the "Sealark" specimen as in the type of *P. tenuilaminaris*, but in spite of the specific name, somewhat unfortunately chosen, this character cannot be regarded as of great importance. Lendenfeld [1903] regards *P. tenuilaminaris* Sollas as a synonym of *P. crassiuscula* Sollas, but I doubt whether this is justifiable in the present state of our knowledge. The chief distinguishing feature of the species appears to be the absence of short-spined spirasters.

Previously known Distribution. South of Japan, 775 fathoms ("Challenger"); Japan (Lebwohl).

Register No., Locality, &c. LXXII. 2, Amirante.

Genus Yodomia Lebwohl [1914].

Pachastrellidæ in which the principal megascleres are calthrops (or short-shafted triænes), mesotriænes and oxea, with various derivatives of these often exhibiting very abnormal characters. The microscleres consist of amphiasters (or possibly some other form of aster) and microrhabds.

This genus has recently been proposed by Lebwohl [1914] for the reception of a remarkable Japanese species, *Yodomia ijimai*, which agrees with Triptolemus in the presence of mesotriænes but differs in the possession of calthrops (or triænes) and oxea as well, thereby approximating to the more typical Pachastrellidæ. The presence of abnormal-looking derivatives of the megascleres, sometimes forming spheres, appears also to be very characteristic.

Lebwohl gives the following diagnosis of his new genus "Pachastrellidæ mit langschäftigen Triænen; mit radial orientirten Plagiotriænen und Mesotriænen an der Oberfläche." It appears to me that he has here laid undue emphasis on the long-shafted triænes, which are far from being typical long-shafted triænes and are said to be relatively scarce. In the new species discovered by the "Sealark" expedition they do not occur at all.

The genus Triptolemus, proposed by Sollas in 1888, includes small encrusting forms, and may possibly be regarded as having been derived from Yodomia by reduction of the spiculation.

Schmidt's *Stelletta pathologica* [1868] from the coast of Algiers, redescribed by Sollas in 1888, also includes mesotriænes in its spiculation and is perhaps a nearly related form.

3. *Yodomia perfecta* n. sp.

(Plate **44**, figs. 2, 2 *a*; Plate **45**, fig. 3.)

The external form of the sponge is irregular and variable. Thus R.N. x. 1 (Plate **44**, fig. 2) forms a flat, spreading crust about 8 mm. in thickness, with an uneven, nubbly

surface and strongly hispid in places, especially along part of the margin, where dense tufts of oxea project for as much as 3 mm.; the entire crust is about 55 mm. in length and 27 mm. in greatest breadth; irregularly oval in shape. R.N. x. 2 and x. 3 are essentially similar to R.N. x. 1. R.N. vi. (Plate **44**, fig. 2 *a*), on the other hand, has the form of a thick, vertical, wall-like plate, attached without any spreading base to a stone. The two sides of the plate are flattened but rather uneven, the margin broadly rounded, the surfaces alike, coarsely granular in appearance but at the same time slightly hispid in places. The entire specimen measures about 50 mm. in length, 30 mm. in height and 18 mm. in maximum thickness. R.N. ix. 1 closely resembles R.N. vi.

None of the specimens show any oscula. The texture is compact, firm and very harsh to the touch. Colour in spirit pale, dull yellow.

The skeleton is a dense, confused mass of large and small calthrops and small mesotriænes, penetrated here and there by loose wisps or bundles of oxea, running towards the surface. The relative numbers of the large and small calthrops vary greatly in different specimens. The microrhabds are abundantly scattered all through the sponge but are accumulated in an especially dense layer at the surface.

Spicules. (1) Large calthrops or short-shafted triænes (Plate **45**, figs. 3 *a*—3 *a*″). Rays generally about equal in length, sometimes straight and sometimes curved or crooked; sometimes sharp-pointed and sometimes rounded off, sometimes (in R.N. ix. 1) reduced to rounded knobs, so that the whole spicule may become almost spherical (fig. 3 *a*″); occasionally divided into two short branches at the extremity (figs. 3 *a*, 3 *a*′); size very variable; rays measured up to about 1·5 by 0·15 mm.

(2) Small calthrops or short-shafted triænes (figs. 3 *b*, 3 *b*′). Rays usually straight, gradually sharp-pointed; sometimes differing a good deal in length, while more frequently the three which are alone fully visible at the same time appear to be about equal; length very variable, say about 0·2 mm., with a diameter of about 0·03 mm. Numerous intermediate sizes between these and the large calthrops also occur.

(3) Mesotriænes (figs. 3 *c*—3 *c*″). The three cladi spring from about the middle of a short shaft. The cladi are always branched, usually bifurcating once only but occasionally twice. All the cladi and both ends of the shaft are gradually sharp-pointed. Size very variable, say about 0·2 mm. across the cladome, from tip to tip of cladi, in R.N. x. 1, but may be at least twice this size in R.N. vi. Each half (ray) of the straight, unbranched shaft (rhabdome) is about as long as the cladi. An abnormal form with four cladi has been met with and one with only one ray of the rhabdome developed.

(4) Oxea (fig. 3 *d*). Very long, straight and slender; tapering very gradually to each extremity; measured up to 7·7 by 0·04 mm.

(5) Amphiasters (fig. 3 *e*). The shaft between the two whorls of rays is so short that the spicule looks like an oxyaster, especially when seen obliquely or end on, but I think it is really an amphiaster. The rays are long, slender and sharply pointed, altogether about 10 in number. Total diameter of spicule about 0·016 mm. These spicules are abundantly scattered through the sponge.

(6) Smooth microrhabds (fig. 3 *f*). Oval, measuring about 0·012 by 0·006 mm. Extremely abundant throughout the sponge, but especially so at the surface. Sometimes

varying to more slender forms as shown in the figures, and even passing into the next form.

(7) Spined microrhabds (fig. 3 *g*). Slender; covered with minute short spines; measuring about 0·022 by 0·002 mm. (exclusive of spines), but variable. This spicule is extremely scarce in some specimens, though plentiful in others, so that it may very easily be overlooked. It seems to be a characteristic feature of the genus Triptolemus and is probably proper to Yodomia also. It may be a reduced streptaster.

The condition of the material and the character of the skeleton make it impossible to prepare satisfactory paraffin sections, but investigation by this method reveals the presence of an enormously thick, gelatinous ectosome. This tissue appears to be of the nature of that termed "chondrenchyme" by Sollas [1888]. Imbedded in the clear, gelatinous, faintly staining matrix are numerous oval, granular cells, about 0·02 mm. in diameter, each with a small nucleus and each surrounded by a well-defined shrinkage cavity or lacuna in the matrix, usually much larger than itself. The relative proportion of cells and matrix varies in different parts, but generally the cells lie pretty close together. The outermost portion of the ectosome is occupied by the thick layer of oval microrhabds.

This species in many respects resembles Lebwohl's *Yodomia ijimai* from Japan, but it differs in important details of spiculation. Thus the mesotriænes of *Y. ijimai* have simple cladi while in *Y. perfectus* they are branched; *Y. perfectus* has no long-shafted triænes and *Y. ijimai* appears to have none of the smooth oval microrhabds which are so abundant in our species.

Register Nos., Locality, &c. VI., IX. 1, X. 1, 2, 3, 4, all from Saya de Malha, 4.9.05, C. 1, 150 fathoms.

Family **Stellettidæ.**

Astrotetraxonida with long-shafted triænes; without calthrops, sterrasters and aspidasters. (In a number of genera and species with reduced spiculation, constituting the so-called family Epipolasidæ, the tetract megascleres have completely disappeared, while in certain forms the astrose microscleres seem to have vanished.)

The original Stellettids appear to have arisen by the development of long-shafted triænes and the radial arrangement of the megascleres in some primitive pachastrellid ancestor. It is a very remarkable and interesting fact that along a number of more or less distinct lines of descent within the stellettid family the power to produce tetract megascleres seems to have become exhausted and these lines have passed over into the monaxonellid condition. It was for such lines that Sollas [1888] proposed the family Epipolasidæ, which he placed as an "Appendix" to his Astrophora Euastrosa (= Stellettidæ). In the Epipolasidæ he recognised three genera, Amphius, Asteropus and Coppatias. His diagnosis of the family fully recognises the principle of the loss of tetract megascleres, it runs as follows:—"Euastrosa (?) without triænes, possessing oxeas and one or more forms of aster. The oxeas arranged partly in radiating fibres, partly scattered loosely

in the choanosome; in the ectosome they lie tangentially. The chamber system (so far as investigated) diplodal*" (p. 177).

Since 1888 a considerable number of species have been assigned to the "Epipolasidæ" and it has become increasingly evident that the group is of polyphyletic origin. It is perhaps not even certain that all Epipolasids are reduced Stellettids, for it is quite conceivable that similar reduction may have taken place in primitive Pachastrellids and given rise to Epipolasids which never passed through a stellettid stage in their ancestry. Apart from this question, however, it is by no means difficult to find, amongst the known Stellettidæ, genera, or even species, which seem to represent very closely the ancestors of certain Epipolasids. Sollas himself pointed out that "If *Asteropus* is a reduced *Stellettid* it is to *Stryphnus* that we must look for its nearest alliance" (*l.c.* p. 206). In another part of the same work, however, he expresses the strong opinion that "*Asteropus* has resulted from an *Algol* by the loss of triænes" (p. cxlii).

In 1905 I pointed out that the epipolasid genera Coppatias (now sunk in Jaspis) and Cryptotethya are evidently very closely related to Stelletta, and said that "Cryptotethya may be regarded as derived from some such form as *Stelletta herdmani* by further reduction of the triænes and by the outgrowth of the ectosome into finger-like processes" (p. 110).

Most remarkable, however, is the existence of three epipolasid species, viz. *Rhabdastrella distincta* Thiele, *Diastra sterrastræa* Row and *Aurora cribriporosa*, n. sp., each of which is represented by a closely related, triæne-bearing species in the stellettid genus Aurora. The relationships of these species will be discussed later on.

In view of these facts it seems to me that the time has now arrived when we may conveniently abandon the family Epipolasidæ altogether and distribute its members as best we can amongst the Stellettidæ, and, if subsequent research should render it necessary, amongst the Pachastrellidæ also.

Genus Myriastra Sollas [1886].

Stellettidæ with or without a distinct fibrous cortex and with only one form of microsclere, a chiaster.

This genus has been sunk by Lendenfeld [1903] in Stelletta, but it appears to me convenient to retain it, at any rate pending a much needed revision of the Stellettidæ. It seems impossible, however, to draw a real distinction between *Myriastra* and *Pilochrota*, for all degrees of development of the fibrous cortex occur in different species of these genera. I therefore propose to merge Pilochrota in Myriastra.

4. *Myriastra parva* (Row).

Pilochrota parva Row [1911].

This species is represented in the collection by a small fragment about 6 mm. in greatest diameter and of a pale, dull yellow colour.

* On p. 141 he says "aphodal."

The skeleton is dense, radially arranged, and the spiculation very typical, as follows :—

(1) Orthotriænes; with simple unbranched cladi; shaft straight, tapering gradually to a sharp point, measuring about 0·76 by 0·026 mm.; cladi gradually sharp-pointed, measuring about 0·15 by 0·026 mm.

(2) Anatriænes; numerous and frequently projecting beyond the surface. Cladi strongly recurved. Shaft very long and slender, measuring about 0·9 by 0·0086 mm. Cladi gradually sharp-pointed, about 0·034 mm. long.

(3) Oxea; straight or nearly so, fairly gradually and sharply pointed, measuring up to about 0·9 by 0·02 mm. Considerably shorter and more slender forms also occur.

(4) Chiasters (tylasters); very minute, with very slender rays and very small heads; total diameter about 0·008 mm. Scarce.

The cortex is very feebly developed and not sharply differentiated from the choanosome; say about 0·12 mm. thick. It contains very little fibrous tissue and the large subcortical crypts push their way through it to within a short distance of the surface, lying between the distal portions of the bundles of large orthotriænes, whose cladi are extended actually at the surface. The inhalant pores seem to open singly by short, narrow canals into the subcortical crypts. An inner zone of smaller orthotriænes extend their cladi beneath the subcortical crypts.

The "Sealark" fragment agrees closely with the type of the species from the Red Sea, as described by Row. I have examined one of Mr Row's preparations of the type and can find no important difference. I cannot find the slender, hair-like oxea which he describes and figures, but which I cannot regard as of any taxonomic importance.

The species is evidently closely related to Sollas's *Myriastra simplicifurca* [1888] from Torres Strait; differing, however, in the much smaller size of the spicules. It also comes near to Hentschel's *Stelletta tuberosa* [1909] from S.W. Australia, from which it differs in the form of the cladome of the anatriæne, the cladi being, usually at any rate, much more strongly recurved. Hentschel also mentions the occurrence of small, slender oxea here and there in the choanosome in his species. They are probably merely young individuals of the large oxea. Probably all three forms will have to be united as varieties of one and the same species, but it would be premature to do this at present.

Previously known Distribution. Red Sea (Row).

Register No., Locality, &c. LV. 1, Coetivy.

5. *Myriastra cavernosa* n. sp.

(Plate **44**, figs. 3, 3 *a*; Plate **46**, fig. 1.)

Sponge (Plate **44**, figs. 3, 3 *a*) massive, irregularly subspherical; without definite points of attachment but more or less thickly encrusted with nullipores and Orbitolites. Surface uneven, granular, occasionally hispid where well protected. A few rounded openings, say about 3 mm. in diameter, irregularly scattered between the débris on the surface, and without prominent margins, probably represent the vents. They communicate with the extensive system of wide canals which ramify all through the interior

of the sponge and give it its characteristic cavernous appearance when cut open. In the outer part of the sponge these canals often approach very close to the surface, being covered in only by a thin membrane. Texture compressible, resilient, fairly compact between the wide canals. Colour in spirit light yellowish grey. There are four specimens in the collection; three of these have each a diameter of about 40 mm., while the fourth is much smaller.

The skeleton, at any rate towards the surface, is radially arranged, consisting of large, stout oxea and orthotriænes grouped to some extent in loose, very ill-defined bundles. Most of the triænes are in the outermost portion and have their cladi extended at or very near the surface.

Spicules:—(1) Orthotriænes (Plate **46**, fig. 1 *a*); with stout, straight or nearly straight shaft, usually tapering very gradually to a fine point. Cladi simple, stout, nearly straight; extended nearly at right angles to the shaft but inclined slightly forward and then slightly recurved (may be slightly inclined forward again towards the apex). Shaft measuring up to about 2·0 by 0·066 mm., with cladi about 0·27 by 0·066 mm.

(2) Oxea (fig. 1 *b*); long, stout, fusiform, slightly and gently curved, usually gradually and sharply pointed at each end; measuring up to about 2·6 by 0·07 mm.

(3) Oxea (fig. 1 *c*); short, slightly curved, fairly sharply pointed at each end; measuring about 0·155 by 0·0086 mm. A few of these occur scattered through the choanosome; they are possibly foreign.

(4) Chiasters (fig. 1 *d*); small, with slender, slightly tylote rays; total diameter about 0·013 mm.

There is a good deal of fibrous tissue in the thin ectosome (only about 0·085 mm. thick), but the ectosome is not very sharply differentiated from the underlying choanosome and it is impossible to speak of a distinct cortex.

This species seems to differ from most species of Myriastra in the absence of the anatriæne, of which I have found no trace. Its curious cavernous character and general habit are also probably very distinctive.

Register No., Locality, &c. VII. 5, Saya de Malha, 6.9.05, C. 15, 55 fathoms. Four specimens.

Genus Dragmastra Sollas [1888] *emend.*

Stellettidæ in which the microscleres consist of euasters and trichodragmata.

Sollas restricts this genus to corticate species in which the middle or collenchymatous layer of the cortex is crowded with trichodragmata. I have already pointed out that the degree of development of the cortex in the Stellettidæ is so variable, and so many transitions occur, that it does not form a satisfactory generic character. I therefore omit all reference to the cortex from the diagnosis of this genus.

Sollas [1888] expressly excluded Carter's *Stelletta lactea* from the genus Dragmastra, on the ground that "the orthodragmas [= trichodragmata], as stated by Carter, are confined to the choanosome, and there is no necessity therefore to assign it to *Dragmastra*, with which it is evidently not nearly related."

I cannot, myself, see why it is not nearly related to Dragmastra, and I find, in the

variety about to be described, that the trichodragmata occur in the cortex as well as in the choanosome. I therefore think that Dragmastra is the genus to which *Stelletta lactea* must be assigned.

6. *Dragmastra lactea* (Carter) var. *mauritiana* nov.

(Plate **46**, fig. 7.)

Stelletta lactea Carter [1871 A].
Stelletta lactea Norman [Bowerbank 1882].
Pilochrota (?) *lactea* Sollas [1888].
Pilochrota lactea Topsent [1894 G].
Stelletta lactea Lendenfeld [1903].

Mr Carter originally described this species from the coast of Devonshire, and stated that it is "massive, spreading, fixed, following and filling the cavities of deciduous small boring shells (*Saxicavæ*) and Annelids, which confine themselves to the surface of the sandstone rock in which they live, almost entirely concealed by overgrowths of small Cirripedes and Fuci, and communicating with the exterior only through the openings of the cavities mentioned."

It is very interesting to find a closely related form, obviously a variety of the same species, adopting a similar "cryptozoic" mode of life at Mauritius.

The single specimen forms a thin crust, growing upon a horny sponge (R.N. CXXVI. 4) beneath a specimen of *Latrunculia* (R.N. CXXVI. 4 C). The main skeleton consists of dichotriænes and oxea; the dichotriænes being mostly arranged in loose brushes with their cladomes just beneath the surface, while others are irregularly scattered in the deeper parts of the sponge. A few of the oxea are radially arranged, but most of them seem to be irregularly scattered, singly or in bundles.

Spicules:—(1) Dichotriænes (Plate **46**, fig. 7 *a*); shaft short and stout, gradually sharp-pointed, characteristically bent somewhat to one side at about one quarter of its length below the cladome, measuring about 0·4 by 0·0258 mm; cladi very short, each bifurcating into two short, sharply conical branches about equal in length to the main branch; total diameter of cladome about 0·1 mm. A few much more slender triænes, with unbranched cladi, also occur; these I take to be young forms of the dichotriænes.

(2) Oxea (fig. 7 *b*); nearly straight, fusiform; gradually and fairly sharply pointed; measuring about 0·75 by 0·02 mm., but frequently more slender.

(3) Oxyspherasters (fig. 7 *c*); very minute, sometimes with well-developed centrum and numerous very slender rays about as long as the diameter of the centrum, but the proportions are variable; total diameter about 0·008 mm. Especially abundant in a superficial layer. A few (fig. 7 *d*) occur as much as 0·016 mm. in diameter, usually with long, slender rays and relatively small centrum.

(4) Trichodragmata (fig. 7 *e*); very numerous in some parts of the sponge, rare in others; measuring about 0·02 by 0·004 mm.

The small size and general condition of the sponge do not allow of my saying much about its minute anatomy or histology. There is no distinct fibrous cortex, but there appears to be a thick gelatinous ectosome (about 0·86 mm. thick), distinguished by its lighter colour and clearer appearance from the underlying choanosome.

This variety differs from the type of the species chiefly in the much smaller size of the megascleres and in the fact that all the triænes when full-grown seem to be dichotriænes.

Previously known Distribution. Devonshire coast (Carter); French coast (Topsent).

Register No., Locality, &c. CXXVI. 4 E, Mauritius, 23.8.05.

Genus Rhabdodragma n. gen.

Stellettidæ with (?always) a very strongly developed, partly fibrous cortex. The microscleres include asters, microrhabds and trichodragmata.

This genus stands in the same relation to Sollas's Psammastra as that in which the same author's Dragmastra stands to Stelletta. Stelletta includes forms without microrhabds and without trichodragmata, while Dragmastra includes forms with trichodragmata but no microrhabds. Psammastra includes forms with microrhabds but without trichodragmata, and is perhaps indistinguishable from Ecionemia, while Rhabdodragma includes forms with both microrhabds and trichodragmata, in addition, of course, to the asters.

Topsent's genus Sanidastrella [1892 D] cannot, in my opinion, be distinguished from Psammastra, for the so-called sanidaster merges into the microrhabd type of spicule, as the figures given by Topsent [1894 G] clearly show.

We have here a group of usually corticate Stellettidæ which are evidently all closely related to one another but in which the microscleres show great variation from genus to genus. The presence or absence of such distinct types of microsclere as microrhabds and trichodragmata appears to me to afford good ground for generic distinction, and the same may be said of the characteristic spherasters of the genus Aurora and the sterrasters of the Geodiidæ and Erylidæ, but we cannot attribute a like value to the extremely variable oxyasters (and chiasters and other related forms), as Lendenfeld [1903] has done in attempting to differentiate subgenera of Stellettidæ.

Kieschnick's *Psammastra conulosa* from Ternate, first adequately described by Thiele [1900], is the type and so far only known species of the genus, and it is extremely interesting to meet with this little-known sponge again at Cargados Carajos.

7. *Rhabdodragma conulosa* (Kieschnick).

(Plate **44**, fig. 7; Plate **47**, fig. 1.)

Psammastra conulosa Kieschnick [1896].
Psammastra conulosa Thiele [1900].

There are in the collection three specimens of this remarkable sponge, two large and one small, all from Cargados Carajos. The type specimens, from Ternate, were only about 1 cm. in diameter, but the smallest of the "Sealark" specimens has a diameter of about 2 cm., while the largest has a diameter of about 6 cm., being nearly as large as a cricket ball. The external appearance (Plate **44**, fig. 7)

is very characteristic, the surface being beset with irregularly arranged, more or less elongated conuli. These conuli are stiff and supported by spicule bundles. In addition to the conuli there are short, root-like attaching processes on the lower surface. Between the conuli the surface is in many places minutely reticulate, with pore-sieves in the meshes of the reticulation. There are no conspicuous vents, and it appears probable that the exhalant openings are covered over by sieve-nets. The smallest specimen is almost spherical, but the two larger ones are both slightly flattened dorsoventrally, and the largest (fig. 7) has a rather prominent equatorial ridge, dividing the more flattened upper from the more convex lower surface ; on this ridge the conuli are especially numerous. The colour in spirit is dark purplish-brown. All the specimens show clearly the small white specks due to the accumulation of trichodragmata just beneath the surface, as described by Thiele. The texture is firm and compact.

The cortex, in the largest specimen, is about 3 mm. thick. It is divided into two very distinct layers, an outer, soft, pigmented one, to which the colour of the sponge is due, and an inner, very dense, fibrous one with only occasional pigment cells. The inner, fibrous layer is very much more strongly developed than represented in Thiele's figure, the difference being no doubt correlated with the much larger size and presumably greater age of the specimen. It makes up considerably more than half the thickness of the cortex and is composed of an extremely dense interlacement of fibre-tracts running in all directions. From its outer surface fibre-tracts run into the outer layer of the cortex, where they form a loose network, concentrated, however, towards the surface and around the radially arranged bundles of megascleres. In the meshes of this network lie the large vesicular pigment cells described by Thiele, the pigment being most strongly developed in the deeper part of the layer. The outer layer of the cortex also contains great rounded masses of trichodragmata.

The inner layer of the cortex is pierced by narrow canals, which may branch and anastomose with one another and frequently unite to form wide chones, and whose course is clearly marked out by the microrhabds lying in their walls. In the outer layer of the cortex the canals are not easy to follow, but they appear to be still narrow and no doubt lead inwards from the dermal pores.

Beneath the fibrous layer of the cortex there is a much thinner collenchymatous layer containing numerous subcortical crypts. This layer also contains a good many pigment cells.

I am unable to say anything definite about the exhalant canal system, but there is good reason to believe that it is similar to that described by Topsent [1894 G] for his *Sanidastrella coronata*, a sponge which is obviously nearly related to our species. In that sponge the exhalant canals open at the sides of the much elongated dermal appendages (corresponding to the conuli of Rhabdodragma), not by large openings but through sieves. At the same time it seems probable that in our species the exhalant openings are not confined to the conuli.

The skeleton of the choanosome is very dense, consisting of pretty closely packed, radially arranged, large oxea and plagiotriænes. Most of these terminate below the cortex, but here and there, at wide intervals, dense bundles of oxea and plagiotriænes penetrate

the cortex and either reach the surface of the sponge between the conuli or are continued into the conuli.

Spicules:—(1) Plagiotriænes (Plate **47**, fig. 1 *a*); with stout shaft and short, stout, often somewhat incurved cladi; shaft sharply and very gradually pointed, cladi sharp or blunt; shaft about 2·5 by 0·068 mm.; cladi about 0·14 by 0·04 mm.

(2) Oxea (fig. 1 *b*); stout, fusiform, straight or nearly so, gradually and finely pointed at both ends or with ends somewhat blunted; measuring sometimes as much as 4 by 0·07 mm.

(3) Chiasters (fig. 1 *c*); with about eight rather slender, usually slightly roughened rays each ending in a small oval knob (I have seen one specimen with spiny instead of knobbed ends, as described and figured by Thiele); usually about 0·02 mm. in total diameter but sometimes nearly twice as much.

(4) Slender oxea (fig. 1 *d*); straight, gradually sharp pointed at each end, with very faintly roughened surface; measuring about 0·266 by 0·005 mm.

(5) Microrhabds (fig. 1 *e*); short, thickly covered with small, short spines; varying in diameter; say about 0·012 by 0·004 mm., including spines. Especially abundant in the dermal membrane.

(6) Trichodragmata (fig. 1 *f*); each dragma about 0·03 by 0·012 mm.; readily breaking up into hair-like raphides. Enormously abundant and sometimes collected in large oval or spherical masses, especially in the outer part of the cortex.

A careful comparison with Thiele's excellent description and figures leaves no doubt as to the specific identity of the "Sealark" with the Ternate specimens. Yet Lendenfeld [1903] speaks of the asters as "oxyasters" (Thiele simply calls them asters), while in our specimens they are chiasters with knobbed ends, the difference between the two being extremely minute; and Thiele regards the spiny microrhabds as sanidasters! These facts show the utter hopelessness of basing generic distinctions upon oxyasters and sanidasters as distinct from chiasters and microrhabds. I think a comparison of my figures of the spicules with those given by Thiele will fully justify the identification.

Previously known Distribution. Ternate (Thiele).

Register Nos., Locality, &c. LXXVIII. 1 A, B, 3, Cargados Carajos, 28.3.05, B. 2, 30 fathoms.

Genus Ecionemia Bowerbank [1862 c].

Stellettidæ in which the microscleres include microrhabds in addition to euasters; the former are commonly minutely spined or roughened and usually form a dermal layer. There are no trichodragmata.

I accept this genus in the same sense as that in which I employed it in my Ceylon Pearl Oyster Report [1905]. I cannot at present enter into the very difficult and complex question of its relationship to Ancorina and other stellettid genera and sub-genera, but I may say that neither the arrangement of Sollas [1888] nor that of Lendenfeld [1903] appears to me satisfactory. There can be no doubt that the species which I include in Ecionemia are closely related to *E. acervus*, Bowerbank's type of the genus.

8. *Ecionemia carteri* Dendy.

Ecionema carteri Dendy [1905].

This species is represented in the collection by a number of specimens, varying in shape from almost spherical to irregularly massive, and in colour from light to dark brown. They agree very closely with the Ceylon form and I need add nothing to my original description except the statement that granular brown pigment cells occur in very varying numbers in the outer parts of the sponge, both in the Ceylon and in the "Sealark" specimens.

Previously known Distribution. Ceylon (Dendy).

Register Nos., Localities, &c. LII. 3, 6, Coetivy; LXXI. 2, Amirante, 17.10.05, E. 21, 30 fathoms; LXXVIII. 18, Cargados Carajos, 28.3.05, B. 2, 30 fathoms.

9. *Ecionemia laviniensis* Dendy.

(Plate **44**, fig. 6; Plate **46**, fig. 5.)

Ecionema laviniensis Dendy [1905].

There is a single specimen (Plate **44**, fig. 6) of this species in the collection, considerably larger than the type; irregularly massive, potato-like, in form, and measuring 46 mm. in longer diameter. The surface is marked here and there by very irregular, strongly hispid grooves, some of which contain openings which may be vents. Elsewhere the surface is rather uneven, granular and minutely porous. Only a small quantity of calcareous débris is attached to the surface. The texture is hard, incompressible. The colour in spirit is light purplish brown.

In spiculation this specimen agrees closely with the type, but the cladi of the dichotriænes (Plate **46**, figs. 5 *a*, 5 *a'*) are stouter, while the microstrongyla (fig. 5 *g*) appear on an average to be somewhat smaller. Minute chiasters with stout cylindrical rays (fig. 5 *d*) and small, slender-rayed oxyasters (fig. 5 *e*) are both present, together with intermediate forms (figs. 5 *e*, 5 *f*).

Previously known Distribution. Ceylon (Dendy).

Register No., Locality, &c. XI. 2, Saya de Malha, 7.9.05, C. 19, 29 fathoms.

Genus AURORA Sollas [1888].

Stellettidæ in which the principal microscleres are large spherasters (or sterrospherasters), accumulated especially in a cortical layer.

This genus was proposed by Sollas [1888] for the reception of Carter's *Stelletta globostellata* and *S. reticulata*. Lendenfeld [1903] has again merged it in Stelletta, and in this respect he has been followed by Hentschel [1909], but the large spheraster (or sterrospheraster) forms such a characteristic and well-defined feature, and so many species are now known, that it seems to me desirable to retain Sollas's genus. To Carter's species must be added, as typical members of the genus, Hentschel's *Stelletta aurora* [1909] and *Isops membranacea* [1909], and two new ones to be described presently under the names

Aurora providentiæ and *A. rowi*. In addition I propose to include in this genus three reduced or 'epipolasid' species, viz. *Coppatias* (*Rhabdastrella*) *distinctus* Thiele [1900], *Diastra sterrastræa* Row [1911] and *Aurora cribriporosa* n. sp.

Aurora globostellata remains the type of the genus, and I therefore call special attention to the fact mentioned later on (p. 247), that it probably does not possess trichodragmata*, as described by Sollas.

The genus is of great phylogenetic interest as representing almost certainly the starting point for the evolution of the Geodiidæ, as well as for other reasons. To work out this problem as fully as it deserves would require more time and material than I at present have at my disposal, but the following considerations appear to me to leave little doubt as to the results which such an investigation would yield.

The Geodiidæ are, as is well known, distinguished by the possession of a very peculiarly modified spheraster, known as the sterraster, and these spicules form a dense cortical crust. In the more typical forms of Aurora, such as *A. globostellata* and *A. providentiæ*, the characteristic microsclere is a large spheraster with conical rays, very like that of Donatia or Chondrilla, and these also are arranged in a cortical layer. Now in certain species of Aurora, such as *A. membranacea* (Hentschel), *A. sterrastræa* (Row) and *A. rowi*, n. sp., the typical spheraster is either associated with or replaced by a peculiarly modified spheraster resembling a sterraster, which I propose to call a *sterrospheraster* (Plate **46**, fig. 4 *c*). What appears to be this type of spicule was indeed actually described as a sterraster by Hentschel [1909] in his *Isops* (*Aurora*) *membranacea*. The same type of spicule was described by Row [1911] in his *Diastra sterrastræa*, which may be looked upon as an Aurora with reduced spiculation. Row pointed out the resemblance which it bears to a sterraster. He also noted the absence of a "hilum," and it is possible that this may prove to be a distinctive feature of the sterrospheraster, though I think it hardly likely.

Row gave some account of the development of the sterrospheraster in Diastra, and I have been able to work it out somewhat more fully in the case of *Aurora rowi* (*vide infrâ* and Plate **46**, fig. 4). It certainly resembles pretty closely the development of a typical geodiid sterraster, but at the same time it passes through a stage in which it is a fairly typical spheraster, identical, in fact, with the spheraster of *Aurora aurora*, which has no sterrospherasters. There can be no doubt that the typical spheraster of Aurora, the sterrospheraster, and the sterraster of Geodia, are all closely related spicule-forms, the sterrospheraster being in some respects intermediate between the other two. At the same time we must not forget that a "sterrospira," practically indistinguishable in the adult condition from the sterraster of the *Geodiidæ*, has arisen independently in the spirastrellid genus *Placospongia*, as shown by Vosmaer and Vernhout [1902].

The sterrospheraster, however, actually occurs in certain undoubted Geodiidæ, as, for example, *Geodia carteri* Sollas [1888, p. 247], associated with true sterrasters. Carter, who originally described that species from the south coast of Australia under the name *Geodia canaliculata*, Sdt., and figured the spicules [1883 B], regarded the sterrospheraster

* Sollas [1888] uses the term "orthodragma," but the spicules in question are identical with the spicules described by Ridley and Dendy [1887] as "trichodragmata."

as an abnormal form of spicule*. That this is not the case I have convinced myself by examination of Mr Carter's preparations now in my possession. Schmidt [1868] certainly figured a very similar spicule in his *Geodia canaliculata*, but it is not clear, from the descriptions given by him and by Sollas [1888], whether or not it is associated in this case with a typical sterraster, *i.e.* whether the species is a Geodia or an Aurora.

It is obvious from what has been said that the genus Aurora bridges over to a very large extent the gap between the Stellettidæ and Geodiidæ, and the fact that Hentschel described as a geodiid (*Isops*) a species which I feel constrained to place in the genus Aurora, affords eloquent testimony to the close relationship of the two families†. If asked exactly where we ought to draw the line between the two, I should say that further minute anatomical investigation is needed before the question can be answered. Provisionally we may take the typical, hilum-bearing sterraster as a distinctive feature of the Geodiidæ. The sterrospheraster occurs in both families and cannot be regarded as distinctive of either; indeed we cannot even regard it as affording the basis of a generic separation from Aurora, because of its close relationship to the typical spheraster, the gap between the two being completely bridged over by the adult spheraster of *Aurora aurora* and *A. reticulata* and the developmental stages of the sterrospheraster. There is just the possibility that the spheraster of *Aurora aurora* is not a true spheraster but represents a case of convergence, and that true spherasters do not develop in the same manner as sterrospherasters, but this does not seem very likely, and in any case more information is wanted before we can settle the point.

The close relationship between the Geodiidæ and Stellettidæ was recognised many years ago by Czerniavsky [1879], who proposed the sub-genus Stello-geodia for a species (*Geodia stellosa*) which he regarded as intermediate between the two, with the following diagnosis:—"Membrana sarcodea superficialis, corticem tegens, *stellulas minimas* numerosas breviradiatas continens. Parenchyma præter *globulos* siliceos *stellas* majores numerosas pauciradiatas continet." The author evidently regarded the presence of euasters in addition to the "siliceous globules" as the distinguishing feature of his sub-genus, but such euasters as he figures of course occur abundantly in the genus Geodia itself and are by no means distinctive. On the other hand, it seems probable from his figures and description that the "siliceous globules" are not true sterrasters, and that the sub-genus may be identical with Aurora. The description and figures, however, are not sufficiently accurate to enable me to decide this point, and it hardly seems necessary to abandon the generic name Aurora in favour of Stello-geodia, especially as the type species of the latter appears to contain tylostyles, which are not met with in Aurora, though possibly these spicules are only abnormal forms of the oxea.

As already indicated above, the transition from the tetractinellid to the epipolasid condition by loss of the triæne megascleres appears to have taken place at least three times in the genus Aurora. At any rate there are three epipolasid species each of which

* This is also the view taken by Lendenfeld [1910 A] of the spicules termed by him "sterroids" (*e.g.* in *Geodia variospiculosa*), which seem to be identical with the sterrospherasters.

† It is not impossible that several other species at present included in the Geodiidæ, such, for example, as Hentschel's *Geodia punctata* [1909], may be shown by future research to be Auroras.

is evidently closely related to a corresponding species of Aurora which still retains its triænes. *Aurora* (*Rhabdastrella*) *distincta* (Thiele), with large smooth spherasters but without triænes, is closely related to *Aurora globostellata* (Carter) with large smooth spherasters and triænes. *Aurora cribriporosa*, n. sp., with large rough spherasters but without triænes, is closely related to *Aurora providentiæ*, n. sp., with large rough spherasters and triænes; and *Aurora* (*Diastra*) *sterrastræa* (Row), with sterrospherasters but without triænes, is closely related to *Aurora rowi*, n. sp., with sterrospherasters and triænes.

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Aurora (*Rhabdastrella*) *distincta* was first described by Thiele [1900] as a Coppatias, but he subsequently [1903] separated it from Coppatias under the new generic name *Rhabdastrella*.

Aurora sterrastræa was described by Row in 1911 and also recognised as an epipolasid, for which the new genus Diastra was instituted. If these genera were to be retained it would, I think, be necessary also to propose a new genus for *Aurora cribriporosa*, but all three genera would have to be based upon very inadequate characters. We cannot include all three species in a single genus distinct from Aurora unless we are willing to retain that single genus merely as an artificial one of polyphyletic origin, and any argument in favour of doing this would apply equally to the case of the so-called family Epipolasidæ. There seems nothing for it, then, but to abandon the genera Rhabdastrella and Diastra and place all three species in Aurora. It may be said that we ought also to abandon the genera Amphius, Asteropus and Jaspis (Coppatias), and this I shall be quite prepared to do when I feel as certain about their origin from particular tetractinellid genera as I do in the case of Diastra and Rhabdastrella.

In this connection it is also necessary to say something about Sollas's genus Magog [1888], which was proposed for the reception of Carter's *Chondrilla sacciformis* [1879 B]. This species was described by Carter as having "acerates" (oxea) and "globostellates" (spherasters). Sollas accepted this as correct after examination of one of Carter's slides, and diagnosed the genus Magog thus:—"Tethyidæ in which the rhabdus spicule is an oxea, which is confined to the choanosome."

Were the spiculation of *Chondrilla sacciformis* really as described I think we should be obliged to accept that species also as an epipolasid Aurora. I have in my possession, however, in Mr Carter's cabinet, two microscopical preparations of his *Chondrilla sacciformis*, one consisting of teased fragments mounted in balsam and the other of a number of fair-sized fragments put up dry in a cell. I have examined sections and boiled-out spicules from one of these fragments, but neither in these preparations nor in Carter's own balsam slide can I find any oxea at all. The species is a genuine Chondrilla, identical with Thiele's *Chondrilla grandistellata* [1900]. As to how the mistake arose I can only surmise that the preparation from which Carter's original description was taken, and which is now presumably lost, must have contained, as accidental inclusions, oxeote megascleres of *Rhaphidhistia spectabilis*, which Carter described as a thinly encrusting sponge growing on the same mass as *Chondrilla sacciformis*. That the preparations now in Mr Carter's cabinet, and labelled by himself "*Chondrilla sacciformis*," were made at a later date than the original description seems certain, as they bear the date 1881. That they were taken

from one or more of the original types (there were several specimens on the same mass) seems also certain, for one of the slides is labelled "Bk. Coll. 701. Mauritius," and this number and locality are quoted in the original description. Moreover the size and form of the large spherasters are extremely characteristic (*vide infrâ*, p. 269 and Pl. **48**, fig. 8).

The genus Magog therefore must fall to the ground, (1) as being based upon a serious misconception as to the characters of the type species, which is a genuine Chondrilla, and (2) because even were the type species as represented it would have to be regarded merely as a reduced Aurora.

It seems quite probable that the genus Chondrilla itself has been derived from Aurora by complete loss of *all* the megascleres, and not only of the triænes.

10. *Aurora providentiæ* n. sp.

(Pl. **46**, fig. 2.)

This species is represented by a thin crust, about 25 mm. in greatest breadth, which has apparently been pared off some other object, or possibly sliced off from the surface of a larger specimen of the same species, but if the latter hypothesis be correct it is remarkable that the specimen in question is missing from the collection*. The shape of the fragment is quite irregular. The upper surface is fairly smooth and shows two sieve-like groups of openings, of very varying size, which are evidently oscula. There are a large number of small calcareous foreign bodies scattered over the surface. Colour in spirit pale, dull yellow. Texture cavernous.

There is a thin, fibrous cortex, about 0·1 mm. thick, containing numerous large and small spherasters in its outer portion, and pierced at wide intervals by inhalant chones. Each chone is divided into ectochone and endochone by a thin diaphragm perforated by a pore. The ectochone terminates externally in a single (?) dermal pore, the endochone merges indistinguishably into a subcortical crypt.

In the deeper part of the sponge the skeleton consists of loose bundles of oxea running towards the surface, with many loose oxea scattered between. As these bundles approach the surface they spread out into brushes composed mainly of slender oxea and orthotriænes, the cladi of the latter being extended in or beneath the fibrous cortex, below the layer of large spherasters.

Spicules:—(1) Orthotriænes (Plate **46**, fig. 2 *a*). Shaft varying from gradually and finely pointed to rounded or even knobbed at the extremity. Cladi usually simple, gradually and sharply pointed; rarely bifid for a short distance at the extremity. Shaft measuring about 0·5 by 0·017 mm., but variable; cladi about 0·14 by 0·013 mm., but also variable.

(2) Anatriænes (figs. 2 *b*, 2 *b'*, 2 *b''*). Minute, with long, hair-like shaft and widely extended cladi curving backwards almost on arcs of a sphere. Shaft about 0·37 by 0·001 mm. Cladome about 0·0164 mm. across from tip to tip of cladi; cladi about

* The fact that *Aurora* (*Isops*) *membranacea* [Hentschel 1909] forms a thin crust suggests that *A. providentiæ* not improbably has a similar form.

0·001 mm. in diameter at base, but may be reduced to a mere knob (fig. 2 *b*″). These spicules are very rare in the boiled out preparations, but paraffin sections show them in considerable numbers piercing the cortex and usually projecting freely from the surface, where their cladomes are generally broken off.

(3) Oxea (fig. 2 *c*, 2 *c*′). Very slightly curved, usually gradually and finely pointed at each end; measuring up to about 0·84 by 0·02 mm., but varying a good deal, both in length and diameter, and often very slender.

(4) Large spherasters (fig. 2 *d*); with large centrum and generally sharp-pointed, conical rays, usually more or less roughened on their sides, especially towards the apex; total diameter about 0·04 mm., with rays about 0·008 mm. long. Very numerous, especially in the cortex. Occasionally the rays are all blunted and roughened at the ends, very much as in Hentschel's *Aurora* (*Stelletta*) *aurora* [1909].

(5) Small spherasters and oxyasters (fig. 2 *e*); total diameter about 0·008 to 0·02 mm., variable. Some of these are probably early stages of the large spheraster, but I doubt if this is the case with all.

(6) Oxyasters (fig. 2 *f*); rather large, with straight, moderately stout rays, about 6 or 8 in number and usually more or less roughened. Sometimes there is a small but distinct centrum. Total diameter of spicule about 0·07 mm.

This species is evidently related not distantly to Carter's *Aurora* (*Stelletta*) *globostellata* from Ceylon [1883 B], which has never been satisfactorily described. I have two preparations in Mr Carter's cabinet, evidently made from the type, though labelled "*Stelletta globostellifera*." From an examination of these I find that the principal points in which Carter's species differs from *Aurora providentiæ* are as follows:—(1) The large spheraster has a somewhat smaller centrum and the rays are rather longer, smooth, and often blunted at the ends; (2) The large oxyaster is represented by a smaller spicule with long and very slender rays (apparently the "chiaster" of Sollas's description [1888] but reaching a total diameter of 0·045 mm., whereas Sollas gives 0·015 mm.). I have found no anatriænes, but these are so minute and the cladomes are so easily broken off in the "Sealark" species that I cannot attribute any great importance to their apparent absence in *A. globostellata*. Sollas gives an "orthodragma" as a constituent of the spiculation in *A. globostellata*, but I can find none in Carter's slides nor does Carter himself mention it, so we must suppose that Sollas has made a mistake in this respect. He does not say how he obtained his information.

It is also evident that our species is related to Hentschel's *Aurora* (*Stelletta*) *aurora*, from S.W. Australia, but the details of spiculation afford quite sufficient differences to separate the two.

Register No., Locality, &c. LXXXVI. 2, Providence, 4.10.05, D. 4, 50—78 fathoms.

11. *Aurora cribriporosa* n. sp.

(Plate **44**, fig. 4; Plate **46**, fig. 3.)

The single specimen (Plate **44**, fig. 4) has a broad, oval base of attachment, from which it rises up on all sides like a hillock, culminating in a somewhat excentrically

placed, rounded apex bearing a group of between twenty and thirty minute, sphinctrate vents of varying sizes. The surface is smooth and only slightly uneven; minutely punctate under a pocket lens owing to the thickly and for the most part uniformly scattered pore-sieves. The texture is rather leathery owing to the well-developed cortex, internally somewhat cavernous owing to the more or less radially arranged canals. Colour, throughout, brown, not very dark (in spirit). A small amount of calcareous débris is attached to the surface but there seems to be little or none internally. The longer diameter of the base measures 34 mm., the shorter diameter 17 mm., and the maximum height from base to apex about 17 mm.

The cortex is fibrous and about 0·35 mm. thick. It is much excavated, however, by the large inhalant chones, each divided into ectochone and endochone. The ectochone is conical in shape, with the broad base turned outwards and formed by the thin sieve-membrane pierced by numerous inhalant pores. The ectochone is separated from the endochone by a moderately thick diaphragm of fibrous tissue pierced by a single pore which occupies the apex of the cone. The endochones merge insensibly into the large, irregular, subcortical crypts, which unite together in groups and give rise to the wide inhalant canals which penetrate to the interior of the sponge.

The mesoglœa of the choanosome is finely granular, penetrated by numerous narrow, branching canaliculi. The chamber system cannot be satisfactorily made out in my preparations.

The main skeleton is an irregular feltwork of moderate-sized oxea. These are present abundantly in the fibrous cortex, as well as in the choanosome. Indeed, they almost seem to form a special cortical layer, being arranged paratangentially, while beneath the cortex there is a tendency towards radial arrangement. The radial ones also frequently penetrate the cortex with their outer ends. There are also in the cortex numerous very much smaller, slender oxea, arranged radially and with their outer ends, now mostly broken off, projecting slightly beyond the surface.

The outermost part of the cortex and the thin, pore-bearing membrane which covers over the inhalant chones are densely charged with minute spherasters; beneath this layer lie numerous large spherasters, practically confined to the outer half of the cortex, where the fibrous tissue is less strongly developed. Slender-rayed oxyasters, together with a few of the other kinds, occur scattered through the choanosome.

Spicules:—(1) Oxea (Plate **46**, fig. 3 *a*); very slightly curved, fusiform, usually gradually and finely pointed at each end, occasionally blunted or even becoming stylote, and occasionally with short abnormal branches. Measuring up to about 0·7 mm. in length. Thickness very variable, up to about 0·025 mm. but usually more slender.

(2) Slender cortical oxea; slightly curved; ends varying from sharply and gradually pointed to rounded off. Size about 0·2 by 0·004 mm.

(3) Large spherasters (fig. 3 *b*); with large centrum and conical rays beset with short spines. Total diameter about 0·0287 mm.

(4) Spherasters (fig. 3 *c*); with small centrum and numerous long, slender rays; diameter about 0·016 mm. Fairly common in the cortex; possibly young forms of the large spheraster.

(5) Minute spherasters (fig. 3 *d*); with moderately large centrum and numerous short, strongylote rays; total diameter about 0·008 mm.

(6) Oxyasters (fig. 3 *e*); with no centrum and about 6 or 7 long, slender, slightly roughened rays, usually strongylote. Total diameter about 0·04 mm. Very abundant in the choanosome.

This species must, as already stated, be regarded as derived from some form closely related to *Aurora providentiæ* by loss of the triænes. It is also nearly related to *Aurora* (*Rhabdastrella*) *distincta* Thiele [1900] from Ternate, differing mainly in its rough spherasters.

Register No., Locality, &c. CXIX. 12, Salomon.

12. *Aurora rowi* n. sp.

(Plate **44**, fig. 5; Plate **46**, fig. 4.)

The single specimen (Plate **44**, fig. 5) is an irregularly rounded, massively lobose sponge, attached to a calcareous nodule very much smaller than itself. (There are indications that at least one other large foreign body has been removed from the surface.) The specimen measures about 36 mm. in height, 41 mm. in breadth, and has a very varying thickness up to about 25 mm. The surface is subglabrous; minutely punctate under a pocket lens, and has a curious crumpled appearance, with irregular meandering grooves of varying depth. The oscula are of moderate but variable size, measured up to 2 mm. in diameter; few in number, scattered singly; without prominent margins. The inhalant pores are scattered singly on the surface of the sponge, each in the middle of a small polygonal area.

The colour in spirit is a uniform chocolate brown throughout. The texture is compressible but resilient; fairly compact, but with a tendency towards the inclusion of rather large foreign bodies.

The skeleton is not very dense and somewhat confused, but on the whole shows a marked radial arrangement, consisting principally of very loose wisps of large oxea running towards the surface. In the more superficial part of the sponge occur numerous radially arranged orthotriænes with cladi extended beneath a dermal crust of sterrospherasters and small spherasters.

Spicules:—(1) Orthotriænes (Plate **46**, fig. 4 *a*); shaft well developed, straight, gradually sharp-pointed, measuring about 0·74 by 0·023 mm. Cladi unbranched, slightly recurved, sharply pointed, about 0·16 mm. long.

(2) Oxea (fig. 4 *b*); rather slender, straight or very slightly curved; gradually and sharply pointed at each end, measuring about 1·1 by 0·023 mm.

(3) Sterrospherasters (figs. 4 *c*—4 *h*). The full-grown spicule (fig. 4 *c*) is spherical, with a very large, solid centrum whose surface is covered with close-set, irregular, flattened protuberances, incompletely separated from one another by narrow grooves which form a reticulate pattern. The diameter of the spicule is about 0·04 mm. The development of this spicule is very interesting. The first stage (fig. 4 *d*) is a slender-rayed oxyaster, but apparently the rays may sometimes be truncated (fig. 4 *d'*). A distinct

centrum is then developed between the basal portions of the rays, and the whole spicule at the same time increases in size (figs. 4 *e*, 4 *e'*). As the centrum grows larger the rays grow longer and increase in number. They may still be either sharp-pointed (fig. 4 *f*) or truncated (fig. 4 *f'*), but remain slender, so that their bases stand far apart from one another on the surface of the spherical centrum. As growth proceeds the rays begin to thicken and become bluntly conical. The radius of the centrum is now growing more rapidly than the length of the rays, so that the intervals between the latter become to a large extent filled up, the ends of the rays forming blunt conical projections on the surface of a sphere (fig. 4 *g*). Short spines are now developed at the ends of the rays (fig. 4 *h*). The spheraster has now reached what appears to be the adult condition in *Aurora* (*Stelletta*) *aurora* Hentschel [1909]*. The adult condition in our species (fig. 4 *c*) appears to be arrived at by further development of the terminal spines and by their fusion with one another to form the enlarged extremities of the rays, and with those of adjacent rays to form bridge-like connections between these extremities. There seems to be little doubt that we have here a very interesting case of the recapitulation of phylogenetic history, the penultimate stage in the development of the sterrospheraster, with terminally spined rays, representing an ancestral condition which is still retained as the adult form in *A. aurora*. The oxyaster with which the development commences, and the various intermediate stages, no doubt also represents ancestral adult forms.

The sterrospheraster and its developmental stages are abundantly scattered through the choanosome. The adult form is especially abundant in the cortex.

(4) Small, irregular spherasters without any distinct rays but merely a nubbly surface (fig. 4 *j*). Varying in diameter up to about 0·0082 mm., but usually a good deal smaller. These spicules look as if they might owe their origin to the separation of the enlarged extremities of the rays of the sterrospherasters. They resemble these extremities closely in shape, and usually also in size, though some of them are larger. I have, however, found no evidence of such an origin, and they are probably independent spicules, homologous with the strongylasters of *Aurora aurora*. They are scattered abundantly throughout the sponge, but are especially numerous in the cortex.

(5) Oxyasters (fig. 4 *k*); minute, slender-rayed, with no distinct centrum and about 5 or 6 rays; total diameter about 0·0165 mm. It is very doubtful whether these can be sharply distinguished from the early stages of the sterrospheraster.

The condition of the specimen does not permit of my giving a detailed account of the canal-system and histology, but the following particulars may be noted. There is a thin, fibrous cortex, about 0·2 mm. thick, densely packed, especially in its outer part, with sterrospherasters and spherasters. This cortex is pierced at intervals by chones. Each chone is divided into ectochone and endochone and the two are connected by a very narrow and fairly long canal. The ectochone terminates at the surface of the sponge in a single inhalant pore. The endochone opens into a subcortical crypt, from which, indeed, it is not sharply distinguishable, and the subcortical crypts unite together to form large irregular spaces from which the incurrent canals take their origin. The entire arrangement is very similar to that figured by Keller for *Stelletta siemensi* [1891, fig. 56].

* Compare especially Hentschel's figure of *A. aurora* var. *arenosa* (*loc. cit.*, p. 363, fig. 7).

The choanosome contains numerous large, oval, thin-walled, vesicular pigment-cells, about 0·04 mm. in longer diameter and containing a granular reticulum of brown or yellow pigment to which the colour of the sponge seems to be chiefly due.

This is an extraordinarily interesting species, evidently closely related to *Aurora* (*Stelletta*) *aurora*, Hentschel, *Aurora* (*Isops*) *membranacea* (Hentschel) and *Aurora* (*Diastra*) *sterrastræa* Row. The sterrospherasters are identical with those of Row's species, only somewhat larger*. In *A. sterrastræa*, however, there are no triænes, and Row therefore very naturally included that species amongst the so-called Epipolasidæ. *Aurora rowi* undoubtedly represents very closely the actual stellettid species from which *Aurora* (*Diastra*) *sterrastræa* was derived by loss of triænes. The resemblance between the two is remarkably close, even to the characteristic chocolate-brown colour. Unfortunately Row's description of his species is faulty in certain respects. His account of the cortex is very misleading. He has evidently included as part of the cortex a considerable portion of the choanosome. The special layer of oxea which he describes in the supposed deeper parts of the cortex, 0·5 mm. from the surface of the sponge, does not belong to the cortex at all; moreover it is not a properly defined layer but part of a confused general skeleton. The mistake seems to have arisen through the lack of stained paraffin sections.

Register No., Locality, &c. CXXXI., Seychelles, F. 9, 37 fathoms.

Genus Asteropus Sollas [1888].

Reduced Stellettidæ which have completely lost their tetractinellid megascleres. The main skeleton is a confused feltwork of large oxea. The microscleres are oxyasters and sanidasters.

I have already pointed out that Sollas regarded this genus as probably being derived from either Stryphnus or Algol by loss of triænes.

13. *Asteropus simplex* (Carter).

(Plate **46**, fig. 6.)

Stellettinopsis simplex Carter [1879 B].
Asteropus simplex Sollas [1888].
Asteropus haeckeli Dendy [1905].
Asteropus simplex Hentschel [1909].
Asteropus simplex Dendy [1915].

The single specimen in the collection is a cake-shaped mass about 90 mm. in maximum diameter, flattened below and convex above. A few mammiform projections scattered here and there on the upper surface are penetrated each by several narrow oscular tubes and bear at their summits the rather small vents, most of which appear to be closed. The surface is uneven and encrusted by a good deal of calcareous débris, together with a species of Gelliodes. Texture firm, compact, coarse. Colour in spirit rather dark, purplish brown.

* Row gives the diameter of the full-grown sterrospheraster in *D. sterrastræa* as 0·36 mm. This is obviously a mistake. I find it to be 0·028 mm. by actual measurement from the type.

The main skeleton is a confused, dense feltwork of large oxea, with numerous oxyasters and sanidasters scattered between.

Spicules:—(1) Oxea (Plate **46**, fig. 6 *a*); fusiform, more or less curved; for the most part gradually and sharply pointed, but may be rounded off at one or both ends, *i.e.* stylote (fig. 6 *a'*) or strongylote. Size up to about 2·1 by 0·065 mm.

(2) Oxyasters (fig. 6 *b*); rays slender, sharply pointed, slightly roughened, usually about 10 in number, often springing from a small but distinct centrum; total diameter of spicule about 0·05 mm.

(3) Sanidasters (fig. 6 *c*); with approximately straight axis, usually bifurcate or trifurcate at the ends, and with a number of rather short, strongylote spines coming off irregularly along its length or in two principal whorls; total length about 0·02 mm.

In describing my *Asteropus haeckeli* from Ceylon in 1905 I pointed out its close relationship to Carter's *Stellettinopsis simplex* from Western Australia, and suggested that the future discovery of intermediate forms might justify us in uniting the two. This union has since been effected by Hentschel [1909] on the basis of Australian material collected by the Hamburg South-West Australian Expedition. I have no doubt that he is right, nor have I any doubt that the "Sealark" specimen falls within the same species.

Mr Carter, when he first described the species in 1879 referred to a specimen from Hayti which he believed to belong to the same species, but which differs in small details of spiculation. In 1905 I expressed doubt as to this identification, but a careful examination of Carter's original preparation, now in my possession, convinces me that he was right, and that the differences in spiculation, such as the very slightly inflated ends of the rays of the aster, are not of specific value.

Previously known Distribution. Fremantle, Western Australia (Carter); Port Phillip Heads, Victoria (Carter 1886); South-West Australia (Hentschel); Ceylon (Dendy); Okhamandal (Dendy); Hayti (Carter).

Register No., Locality, &c. LXXVIII. 2, Cargados Carajos, 28.3.05, B. 2, 30 fathoms.

Genus Jaspis Gray [1867 F].

Stellettidæ (?), with oxeote megascleres irregularly interlaced to form a confused skeleton, and with microscleres in the form of euasters (and perhaps microxea which cannot be sharply distinguished from the megascleres).

This genus was proposed by Gray [1867 F] for the reception of Schmidt's *Vioa johnstonii*, with the diagnosis "Spicules of two kinds:—1. Fusiform. 2. Stellate."

Sollas [1888] proposed the genus Astropeplus for the reception of his *Astropeplus pulcher*. Lendenfeld [1896] showed that *Astropeplus pulcher* Sollas is synonymous with *Vioa johnstonii* Schmidt, but unfortunately placed that species in the genus Xenospongia, which had been proposed by Gray [1858] for a totally different sponge. Topsent [1898 B] pointed out that *Vioa johnstonii* cannot be a Xenospongia and relegated it to Sollas's genus Coppatias, which had been defined by Sollas [1888] as comprising "Epipolasidæ in which but one form of aster, and that a euaster, is present." Sollas's Astropeplus thus became for Topsent a synonym of the same author's Coppatias. In his Monograph on the

Sponges of France [1900] Topsent fully discussed the synonymy of *Vioa johnstonii* (up to date) and decided upon the name *Coppatias Johnstoni*, rejecting Gray's generic name Jaspis on the ground that the diagnosis of that genus had no scientific value and could not be accepted. A few years later, however, he had changed his opinion, and in his work on the Sponges of the Azores [1904 A] he accepted Gray's name.

If we are to accept others of Gray's generic names, proposed in the same paper as Jaspis [1867 F], as has lately been done in the case, for example, of Mycale, I certainly do not see how we can refuse to accept Jaspis; indeed, according to the laws of nomenclature, I believe we are bound to accept it, for not only did Gray give a diagnosis but he mentioned a type, and there can be no possible doubt as to what he meant.

The character of the oxea, and especially of the centrotylote microxea of *Jaspis johnstonii*, suggests that this genus may have originated directly from some pachastrellid ancestor without having passed through a stellettid stage, but until we have more evidence that this is the case it seems better to include it with the other "epipolasid" genera in the Stellettidæ.

14. *Jaspis johnstonii* (Schmidt).

(Plate **47**, fig. 2.)

Vioa Johnstonii Schmidt [1862].
Jaspis Johnstonii Gray [1867 F].
Vioa Johnstonii var. Schmidt [1868].
Vioa Schmidtii Carter [1882 A].
Astropeplus pulcher Sollas [1888].
Dorypleres incrustans Topsent [1892 C].
Coppatias inconditus Topsent [1892 D].
Xenospongia johnstonii Lendenfeld [1896].
Asteropus incrustans Lendenfeld [1896].
Coppatias Johnstoni Topsent [1898 B].
? *Dorypleres biangulata* Lindgren [1898].
Coppatias Johnstoni Topsent [1900].
? *Jaspis biangulata* Thiele [1903 B].
Jaspis Johnstoni Topsent [1904 A].
Jaspis johnstoni var. *incrustans* Topsent [1904 A].
? *Coppatias albescens* Row [1911].

The specimen forms a thin crust of a light pinkish-brown colour, spreading over and cementing together a mass of Siliquaria shells and other calcareous débris. The vents are minute and scattered. The soft tissues contain numerous granular brown pigment-cells.

The skeleton is a more or less dense feltwork of small oxea and microxea.

Spicules:—(1) Short, stout, fusiform oxea (Plate **47**, fig. 2 *a*); slightly curved; usually very gradually and finely pointed, but may be a little blunted and may also occasionally become stylote, but styli are rare. Size when full-grown about 0·46 by 0·024 mm.

(2) Microxea (fig. 2 *b*); sharply pointed, curved, usually centrotylote, closely resembling the microxea of Erylus; size very variable, say about 0·08 by 0·004 mm.,

but numerous smaller ones occur and also numerous forms connecting with the larger oxea (1).

(3) Oxyasters (fig. 2 *c*); with no distinct centrum, or quite a small one, and slender rays, usually about eight in number; total diameter of spicule about 0·016 mm.

Topsent has pointed out the variability in the size of the spicules in this species, and also mentions that the smaller oxea are frequently centrotylote. I have therefore no hesitation in identifying the "Sealark" specimen with the European form. I have thought it desirable, however, to give measurements and figures of the spicules of the "Sealark" specimen as a contribution to our knowledge of the range of variation. Topsent [1898 B] has also expressed the opinion that Lendenfeld's *Asteropus incrustans* is identical with *Jaspis johnstonii*, an opinion with which I agree. It appears to me very probable that Row's *Coppatias albescens* from the Red Sea [1911] may belong to the same species, and possibly also Lindgren's *Dorypleres biangulata* from Java [1898], also recorded by Thiele [1903 B], under the name *Jaspis biangulata*, from Ternate.

Previously known Distribution. Adriatic (Schmidt, Lendenfeld); Mediterranean coast of France (Topsent); St Iago, Porto Praya, Cape Verde Is. (Sollas); Azores (Topsent); ? Red Sea (Row); ? Java (Lindgren); ? Ternate (Thiele).

Register No., Locality, &c. LXXVIII. 11, Cargados Carajos, 28.3.05. B. 2, 30 fathoms.

Family **Geodiidæ.**

Astrotetraxonida with triæne megascleres, a cortical layer of sterrasters, and various forms of euasters, to which microrhabds may be added.

The question of the probable origin of this family from the genus Aurora has already been discussed. The classification of the Geodiidæ is an extremely difficult problem and one which cannot be properly tackled without a comprehensive re-investigation of the group. I may state, however, that I have the gravest doubts as to the value of the character and arrangement of the inhalant and exhalant openings for the discrimination of genera, upon which so much stress has been laid by Sollas and subsequent writers. I therefore use the old genus Geodia in a far less restricted sense than is customary, but, laying the greatest stress as usual upon skeletal characters, I have framed the diagnosis thereof so as to exclude Pachymatisma, Caminus and Geodinella, which may conveniently be kept distinct.

I have followed Lendenfeld [1910 B] in referring the genus Erylus to a separate family.

Genus Geodia Lamarck [1815 A].

Geodiidæ with well-developed triænes arranged radially at or near the surface; without microrhabds and without spherules.

15. *Geodia auroristella* n. sp.

(Plate **47**, fig. 3.)

The single specimen, in its present condition, has the form of a thin crust, which has evidently been sliced off either from a larger specimen of the sponge or from some foreign object which it was encrusting. As there is no larger specimen of the sponge in the

collection the latter explanation is probably correct. The specimen measured about 25 mm. in length by 8 mm. in breadth and 3 mm. in thickness. The colour on the surface is almost white, internally more yellowish. The surface is almost smooth, very minutely hispid. A group of some 20 or 30 minute, inconspicuous openings, situate close to the margin, but not in any special depression, represent the vents.

Paraffin sections show that each of the small vents is really covered in by a thin pore-sieve, which roofs over a funnel-shaped chone that penetrates the cortex. The inhalant pores are very difficult to make out, but I conclude from the study of sections that they are scattered over the surface, probably in groups, and lead into narrow canals which penetrate the cortex, anastomosing as they go. The cortex is about 0·7 mm. thick, densely charged with sterrasters and with a superficial layer of minute spherasters. It contains a good deal of fibrous tissue connecting the sterrasters with one another and especially strongly developed round the inner ends of the exhalant chones, where it apparently forms sphincters.

The skeleton in the deeper part of the sponge is confused, but loose bundles of diactinal megascleres radiate towards the surface, terminating distally in tufts of triænes which penetrate the cortex. The stout orthotriænes for the most part extend their cladi in the outermost part of the cortex, just beneath the surface; beyond them again loose tufts of slender spicules project freely and are almost invariably broken off short; some of the latter are very slender oxea (? styli), others are reduced anatriænes with vestigial cladome.

Spicules:—(1) Orthotriænes (Plate **47**, fig. 3 *a*); with long, straight or slightly curved shaft, gradually and finely pointed at the end or somewhat blunted, measuring about 1·7 by 0·034 mm.; with short, stout, sharp-pointed cladi extended almost at right angles to the shaft, measuring about 0·086 by 0·034 mm.

(2) Anatriænes (fig. 3 *b*); with long, slender, almost hair-like shaft, tapering away to a very fine point, and sharply recurved cladi, rather long, slender and gradually and finely pointed. Shaft about 1·7 by 0·008 mm.; cladi about 0·07 by 0·006 mm. The cladome may be reduced to a mere knob.

(3) Oxea (fig. 3 *c*); long, slender, sometimes slightly curved; may be sharply pointed at each end, but more often one or both ends is more or less rounded off, giving rise to stylote (fig. 3 *c'*) and strongylote (fig. 3 *c''*) forms; measuring about 1·4 by 0·023 mm. The long, very slender oxea (? styli) projecting from the dermal surface may be regarded as modifications of these.

(4) Sterrasters (figs. 3 *d*—3 *d''''*); of typical oval form, with distinct hilum and surface reticulation formed by the stellate ends of the fused rays; size about 0·123 by 0·1 mm., but many smaller ones occur which appear to be fully developed. Developmental stages are shown in figs. 3*d'*—3*d''''*.

(5) Spherasters (fig. 3 *e*); with stout, smooth, conical but somewhat irregular rays, resembling an Aurora or Donatia spicule; total diameter about 0·05 mm. Choanosomal (subcortical).

(6) Spherasters (fig. 3 *f*); with relatively longer, more slender and minutely spined, conical rays; total diameter about 0·037 mm. Choanosomal.

(7) Minute spherasters (fig. 3 *g*); with small centrum and short, strongylote (perhaps sometimes tylote) rays; total diameter about 0·008 mm. Choanosomal and dermal.

(8) Oxyasters (fig. 3 *h*); with usually about 8 or 9 slender, minutely roughened rays and inconspicuous centrum; total diameter about 0·02 mm.

In spiculation this species approaches Lendenfeld's *Sidonops oxyastra* [1910 A] pretty closely, but differs in the possession of the large spherasters and perhaps in other details. It also comes near to Carter's *Geodia globostellifera* [1880 B], from the Gulf of Manaar, which has a similar spheraster ("globostellate"), but is only 0·021 to 0·028 mm. in diameter, instead of 0·05 mm. as in our species. Carter's species, however, appears to have protriænes and no anatriænes, and the oxyasters seem to be absent.

Register No., Locality, &c. LXXXVI. 1, Providence, 4.10.05, D. 4, 50—78 fathoms.

Family **Erylidæ**.

Astrotetraxonida with a cortex containing aspidasters. The typical megascleres are triænes and oxea (or strongyla). The microscleres include microrhabds and choanosomal euasters.

The remarkable genus Erylus was included by Sollas [1888] in the family Geodiidæ, as it had been by Gray [1867 F], and this procedure has since been generally followed. In 1910, however, Lendenfeld proposed to remove Erylus to a separate family by itself, to which he gave the name "Erylidæ." He pointed out that Erylus differs very considerably from Geodia and proposed the name "aspidaster" for the characteristic cortical spicule, which had previously been regarded as a sterraster. This spicule is undoubtedly the most characteristic feature of the Erylidæ, and it is quite conceivable that, like the sterrospira of Placospongia, its resemblance to the Geodia sterraster may be due simply to convergence. This view is supported by the fact that Erylus differs from Geodia also in other respects, such as the presence of the very characteristic microrhabd and the absence of anatriænes. The triænes that are present seem to be less differentiated than those of the Geodiidæ and may resemble the short-shafted triænes of the Pachastrellidæ, from primitive members of which family it seems quite possible that the Erylidæ have been independently and directly evolved, while the Geodiidæ have almost certainly arisen through the Stellettidæ.

It is customary at the present time to recognise only a single genus in this family, but it seems possible that we may before long be able to sub-divide it according to the form of the aspidaster. Even if we are able to do this, however, I fear that Ferrer's recently proposed genus Scutastra [1912] will have to be regarded as a synonym of Erylus.

Although a good many species have been described these are for the most part evidently very closely related to one another.

Genus Erylus Gray [1867 F].

With the characters of the family.

16. *Erylus lendenfeldi* Sollas.

(Plate **47**, fig. 4.)

Stelletta euastrum Carter [1880 B, p. 136], not Schmidt.
Erylus lendenfeldi Sollas [1888].

I am not aware that this species has been met with since it was first described by Carter in 1880 from Fremantle, Western Australia, and Carter's description was taken from a single dry specimen. It seems therefore worth while to describe it again.

The single specimen in the "Sealark" collection is cushion-shaped, subspherical, about 16 mm. in maximum diameter. It has been torn off from some attachment below. It bears a single circular vent, about 2 mm. in diameter, not far from the centre of the upper surface, without any oscular collar or fringe of any kind. The inhalant pores are distinctly visible under a pocket lens, scattered irregularly and singly over the general surface, each with a narrow whitish margin; sometimes widely open and sometimes closed to varying extents. The surface is smooth and of a dark, greyish-brown colour; the interior is yellow. Texture firm and fairly compact, but with a wide oscular tube running up to the vent and appearing (broken across) on the lower surface, which suggests that there may have been a good deal more of the sponge below.

Skeleton confused internally, radially arranged towards the surface, consisting principally of large oxea but with a fair number of orthotriænes typically orientated beneath the cortex of aspidasters.

Spicules:—(1) Orthotriænes (Plate **47**, fig. 4 *a*); with well-developed cladi, typically unbranched but sometimes irregularly bent and even forked; shaft and cladi tapering to more or less sharp points (often blunted). Size variable, a typical specimen gave the following measurements:—shaft 0·5 by 0·034 mm.; cladi 0·24 by 0·034 mm.

(2) Oxea (fig. 4 *b*); slightly curved, tapering at each end to a sharp or blunt point, measuring about 1·0 by 0·026 mm.

(3) Aspidasters (figs. 4 *c*—4 *c''''*); much flattened, oval or irregular in outline, surfaces beset with numerous small, scattered, simple or slightly stellate tubercles; dimensions about 0·17 by 0·082 mm. Young forms radially striate, formed by fusion of slender rays proceeding from a central mass; intermediates smooth, without tubercles.

(4) Large oxyasters (fig. 4 *d*); with no distinct centrum and long slender rays, minutely spined and not quite sharply pointed; rays usually 4 in number, measuring each up to about 0·07 by 0·004 mm.

(5) Small oxyasters (fig. 4 *e*); similar to the last but with rays only about 0·01 mm. long; perhaps young forms; abundant.

(6) Polyactinose oxyasters (fig. 4 *f*); with minutely spined, slender rays and no distinct centrum. Total diameter up to about 0·028 mm.

Intermediate forms between (4), (5) and (6) occur; and some of the small asters may have slightly tylote rays.

(7) Microrhabds (fig. 4 *g*); smooth, curved, often centrotylote and usually bluntly pointed at each end; measuring, say, about 0·07 by 0·006 mm., but variable.

The cortex is about 0·2 mm. thick and is sharply differentiated into two layers—an outer layer forming about four-fifths of the whole and so densely charged with tangentially placed aspidasters, arranged in several layers, that it is impossible to make out its histological characters; and an inner layer, forming the remaining fifth, composed of fibrous tissue. Both layers contain numerous pigment cells, which, in the fibrous layer, are elongated in the same direction as the fibres, *i.e.* parallel to the surface. A few pigment cells also occur in the outer part of the choanosome.

The scattered inhalant pores lead each into a very well-defined chone, subcylindrical in shape but widening out somewhat as it penetrates the cortex, the bottom of the chone being at about the junction of the outer and inner layers of the cortex. A rather thick sphincter diaphragm, formed from the inner, fibrous layer of the cortex, separates the chone from the subcortical crypt into which it opens. The subcortical crypts are irregular spaces which unite together to form wide inhalant canals running almost vertically inwards.

The choanosomal ground-substance is compact and finely granular; the flagellate chambers are subspherical, close-packed, about 0·024 mm. in diameter.

It will be seen that our sponge agrees very closely with Sollas's re-description of the type [1888]. The chief distinguishing feature of the species is evidently the large oxyaster.

Previously known Distribution. Fremantle, Western Australia (Carter).

Register No., Locality, &c. CII. 2, Amirante, 18.10.05, E. 25, 44—20 fathoms.

17. *Erylus proximus* n. sp.

(Plate **47**, fig. 5.)

The single specimen consists of an irregular mass of Siliquaria shells and sponge inextricably mixed together; the whole measuring about 65 by 36 by 25 mm. The entire mass is somewhat flattened dorsoventrally, but the surfaces are very uneven and irregular, with portions of the Siliquaria projecting freely at frequent intervals. What was presumably the lower surface is penetrated by numerous minute, singly scattered, dermal pores, widely open, commonly with distinct whitish margins; numerous minute whitish specks scattered singly over the upper surface represent similar pores in a closed condition. A few open vents, about 1·5 mm. in diameter, occur singly on prominent parts of the upper surface. The colour of the upper surface (in spirit) is purplish or brownish grey; of the lower surface greyish yellow.

The main skeleton is a confused interlacement of large oxea, with a few short-shafted triænes beneath the dermal crust. Some at any rate of the triænes have their cladi extended paratangentially beneath the surface. There is a thin dermal crust formed of the thin, plate-like aspidasters, which also occur scattered abundantly in the choanosome.

Spicules:—(1) Short-shafted triænes (Plate **47**, fig. 5 *a*); much resembling calthrops, but with the cladi extended almost at right angles to the shaft; cladi may be a little longer or a little shorter than the shaft. Shaft and cladi sharp-pointed, stout or slender;

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cladi occasionally bifurcate at the apex. In a typical example the shaft measured about 0·2 by 0·03 mm., cladi about the same. The forms with slender rays are perhaps young.

(2) Oxea (fig. 5 *b*); fairly stout, fusiform, slightly curved and gradually and sharply pointed; varying occasionally to stylote (fig. 5 *b'*) or even strongylote (fig. 5 *b''*) forms; often slightly centrotylote; typical size about 0·7 by 0·025 mm.

(3) Aspidasters (fig. 5 *c*—5 *c''''*); thin, plate-like, oval; usually with fairly even outline; surface beset with numerous, scattered, slightly stellate, short spines or tubercles; size about 0·15 by 0·07 mm. The young forms are very thin, smooth, oval plates, with a marginal fringe of slender spines; radially striate when very young.

(4) Chiasters (fig. 5 *d*); polyactinal strongylasters and tylotasters; about 0·012 mm. in total diameter; sometimes with a distinct centrum.

(5) Microrhabds (fig. 5 *e*); smooth, fusiform, usually slightly curved, usually sharply pointed, often centrotylote; size about 0·053 by 0·004 mm. Abundantly scattered in the choanosome and in the pore-sphincters.

With regard to the microscopical anatomy of the soft parts in this form I have only to note two points. The inhalant pores are situated each in a distinct gap in the dermal armour of aspidasters, and each is provided with a thin sphincter membrane strengthened by numerous microrhabds. The interior of the sponge is charged with numerous small, brown, granular pigment-cells, especially abundant near the surface.

This species comes very near to *Erylus carteri* Sollas [1888], originally described by Carter from the Gulf of Manaar under the name *Stelletta euastrum* [1880 B, p. 135], which was also associated with Siliquaria. The most important difference lies in the fact that the microrhabds (microxea) are smooth, as usual in the genus, instead of minutely spined as described and figured by Carter for the type of the species.

To judge from the emended description given by Sollas [1888], Ridley's [1884 C] *Erylus cylindrigerus* from the Mascarene Islands is perhaps even more closely related to the present species, differing, however, in the lozenge-shaped form of the aspidaster, the form and size of the small asters, and the (constant ?) strongylote form of the main skeleton spicule. It appears to me highly probable that all three species will have to be united in the future.

Register No., Locality, &c. LVII. 7, Cargados, 30 fathoms.

Family **Donatiidæ**

= *Tethyadæ* or *Tethyidæ* auctorum.

Astrotetraxonida without tetractinellid megascleres. With a strongly developed fibrous cortex. Main skeleton composed of radially arranged styli (or oxea ?). Microscleres euasters of various forms, including large spherasters, to which microrhabds may be added.

This family appears to have originated from some corticate stellettid ancestor of the Aurora type. Indeed, if we admit such "epipolasid" forms as *Aurora distinctus*, *A. cribriporosa* and *A. sterrastræa* amongst the Stellettidæ, it is not easy to frame a diagnosis by which the Donatiidæ can be logically excluded from the same family.

It appears, however, that there is a small group of genera, including Donatia (Tethya), Tethyorhaphis and Xenospongia, of monophyletic origin and closely related to one another, in which the loss of the tetractinellid megascleres is absolutely constant and forms the principal distinguishing feature, instead of occurring sporadically as amongst the Auroras. This character, taken in connection with the characteristic spherasters* and the very strongly developed cortex, seems to form a sufficient justification for retaining the family.

Hitherto I have employed the name "Tethyidæ" for this family, on the supposition that the proper name of the typical genus was Tethya and not Donatia. It will be remembered that Sollas expressed himself very emphatically on this point. He says "*Tethya lyncurium* is a combination that by the accepted laws of nomenclature cannot possibly be disturbed, since the species is the type of the genus so named by Lamarck, and accepted and redefined by O. Schmidt in 1862" [1888, p. cxxi]. Until recently the name Tethya has been accepted in this sense by nearly every writer, including Vosmaer, Lendenfeld, Thiele, Topsent and Lindgren.

In 1903, however, Thiele, after consistently using the name Tethya for the genus in question throughout the body of his paper on the "Kieselschwämme von Ternate," remarked in a footnote that by strict application of the laws of nomenclature Tethya must be substituted for Craniella and Donatia for Tethya. In 1905 Baer followed this up by proposing the family name Donatiidæ, and Lendenfeld [1903], Topsent [1906 B] and Hentschel [1909] have all fallen into line.

It must be admitted that there is nothing in Lamarck's original paper [1815] to justify Sollas's confident assertion. The genus Tethya is there quite unrecognisably defined and *Tethya lyncurium* is the fifth species to be described. The first is *Tethya asbestella*, which, whatever it may be, is certainly not congeneric with *T. lyncurium*. It is true that *T. lyncurium* comes before *T. cranium*, which Lamarck places sixth, but that hardly justifies us in accepting it as the type species of the genus. According to Vosmaer [1887], followed by Lendenfeld [1903], the fourth of Lamarck's Tethyas, *T. lacunata*, is a Geodia! As the generic name Geodia was only proposed by Lamarck himself on a later page of the same volume as Tethya, it certainly looks as if neither *T. lyncurium* nor *T. cranium* had a right to the name Tethya on the ground of priority of mention. But then there are three other species before *T. lacunata*. What these may be I do not know, and I doubt if anyone else does, but if the types are still in existence further researches might upset any decision as to priority which might now be made.

On the whole the wisest course would seem to be to abandon the generic name Tethya altogether and to use Nardo's name Donatia, proposed in 1833, for *D. lyncurium* and its congeners, and Baer's name Donatiidæ for the family.

Genus Donatia Nardo [1833]

= *Tethya* auctorum.

Donatiidæ of usually more or less spherical form; megascleres styli; microscleres large spherasters, with smaller chiasters or oxyasters or both; without microrhabds.

Many species of Donatia have been described by various authors, but the question

* In the aberrant genus Tuberella, however, the microscleres have also completely disappeared.

of their mutual relationships is no less difficult than that of the name of the genus. There is no doubt that members of the genus exhibit very great variability in all those characters that might be used for the purpose of specific distinction; in the character of the surface, the form and size of the microscleres, the arrangement of the microscleres, the thickness of the cortex, &c.

Lindgren [1898] proposed to arrange the described forms in three groups, each of which might be regarded as a species. The names of the three species would then be *lyncurium*, *ingalli* and *japonica* respectively. This arrangement is based on the characters of the smaller asters. In *Donatia lyncurium* the smaller asters are supposed to be oxyasters (0·012—0·02 mm. in diameter) only, variable in form and size but never with tylote rays. In *D. ingalli* the smaller asters are tylote chiasters (0·006—0·016 mm.) and oxyasters (0·02—0·052 mm.). In *D. japonica* the smaller asters are all tylote chiasters (0·008—0·016 mm.). *D. lyncurium* would appear to be characteristic of the North Atlantic and Mediterranean; *D. ingalli* of the Red Sea, Indian Ocean, Malay Archipelago, Australia and the Pacific; *D. japonica* of the Philippines, Java and Australia. I do not think that this arrangement can be accepted, the "lumping" of species appears to be too comprehensive.

In my report on the sponges of Ceylon [1905] I proposed to regard all the specimens of Donatia in Professor Herdman's collection as belonging to three varieties of *Donatia* (*Tethya*) *lyncurium*, which I distinguished as *a*, *b* and *c* respectively. The undoubted existence of transitional forms of the small asters at first sight seems to make it impossible to recognise such forms as *D. lyncurium*, *D. ingalli*, *D. seychellensis* and *D. japonica* as distinct species. There is no reason, however, why either specific or varietal distinctions should be based exclusively upon the characters of the chiasters and oxyasters. The form, size and arrangement of the large spherasters, and the arrangement of the megascleres may also prove useful in this respect, and by taking these into account I now believe it possible to arrive at fairly satisfactory specific distinctions.

It is impossible to discuss in this place all the species and varieties that have been proposed. Nothing but a thorough and tedious revision of the whole genus, based, if possible, upon the examination of type specimens, can lead to any really satisfactory general conclusions.

There are thirty-one specimens of Donatia in the "Sealark" collection, and after careful examination, including measurement of the microscleres of all of them, I have decided to arrange them in five species. None of the specimens are much more than an inch in diameter and many of them are much less; they attain nothing like the size often seen in Australian Donatias.

It will be seen from the locality lists that the different species occur very much mixed together. I have found three species (*lyncurium*, *japonica* and *seychellensis*) in the same jar from Salomon, presumably all obtained in the same haul of the dredge, and a different three (*japonica*, *seychellensis* and *ingalli*) in the same jar from Praslin Reef. These facts show how necessary it is to examine every specimen microscopically before determining to which species it belongs.

18. *Donatia lyncurium* auctorum.

(Plate **48**, fig. 1.)

Tethya lyncurium auctorum.

(For synonymy and literature of the species *vide* Lendenfeld [1896].)

There is in the collection a single very small specimen, only about 8 mm. in diameter, which appears to me to be indistinguishable from the European form. It has a strongly tessellated surface and a few small, root-like attachment processes, and the colour in spirit is nearly white.

The cortex is about 0·86 mm. thick and there appear to be no large intracortical crypts. The radiating bundles of the main skeleton pierce the cortex and spread out into wide brushes, the projecting ends of the component spicules of which render the surface slightly hispid. Beneath the cortex the intervals between the well-defined skeletal bundles are occupied by numerous loose styli or subtylostyli radially arranged.

The large spherasters (Plate **48**, figs. 1 *a*, 1 *b*) are scattered irregularly and rather sparsely in the cortex. They are abundant in the outer part of the choanosome mixed with smaller forms, possibly developmental stages. When fully grown they measure about 0·07 mm. in diameter. Their sharp conical rays are about half as long as the diameter of the centrum.

The cortical chiasters (fig. 1 *c*) are strongylasters or oxyasters, rarely faintly tylote, with usually more than six very slender rays and no conspicuous centrum ; total diameter about 0·012 mm. Curiously enough these spicules appear to be absent from the surface, where, it will be remembered, the cortical chiasters are usually most abundant. The choanosomal chiasters (fig. 1 *d*) are rare and closely similar in form and size to those of the cortex.

Previously known Distribution. European Seas, &c. (For further particulars *vide* Lendenfeld [1896].)

Register No., Locality, &c. CXX. 2 C, Salomon, 10—14 fathoms.

19. *Donatia japonica* (Sollas).

(Plate **48**, fig. 2.)

? *Tethya lyncurium* Deszö [1878].
Tethya japonica Sollas [1888].
Tethya japonica Lindgren [1898].
Tethya lyncurium var. *a.* Dendy [1905].
Donatia japonica Topsent [1906 B].
Donatia parvistella Baer [1905].
Tethya lyncurium Row [1911].

(For other possible synonymy *vide* Lindgren [1898] and Hentschel [1909].)

There are in the collection nine specimens which I think must be referred to this species. They are all more or less spherical in form, and the surface exhibits the usual

range of variation from strongly tessellated in polygonal areas to conulose and proliferous. Although the varying character of the surface causes the specimens to differ very strikingly in external appearance I do not think that it implies any specific or even varietal distinction, but merely phases of growth, possibly associated with a periodic activity in throwing off buds *. None of the specimens exceed a diameter of about 20 mm. The colour in spirit is light grey or yellowish.

The cortex is only about 1·0 mm. thick, with more or less well developed intracortical crypts from which narrow inhalant canals run into the choanosome.

The spicule-bundles of the main skeleton penetrate the cortex and either spread out in brushes at the surface (in the tesseræ) or are continued into well-marked conuli. In the outer part of the choanosome, between the spicule-bundles, numerous loose megascleres (styli or subtylostyli) are radially arranged. These cease abruptly just beneath the cortex.

The large spherasters are rather sparsely scattered in the cortex. In the choanosome their numbers vary greatly and they are apt to be mixed with small forms that probably represent, in part at any rate, developmental stages.

The small tylasters form a distinct dermal layer, as well as occurring scattered in cortex and choanosome.

The spherasters (Plate 48, figs. 2 *a*, 2 *b*), when fully grown, range from about 0·04 to about 0·07 mm. in total diameter. They have sharp conical rays whose length is about half the diameter of the large centrum.

The cortical and choanosomal tylasters (fig. 2 *c*, 2 *d*) closely resemble one another both in form and size and range from about 0·0082 to 0·0164 mm. in total diameter. They usually have more than six rays, but in R.N. XLVII. 2 E they are usually six-rayed.

The chief distinguishing features of this species are the tylote character of the cortical and choanosomal chiasters, the absence of oxyasters and the comparative scarcity of spherasters in the cortex. The choanosomal chiasters may, however, occasionally lose the heads of the rays and exhibit a transition to those of *D. ingalli* (fig. 2 *e*).

I pointed out in my Report on the Ceylon sponges that the tylote character of the chiaster may occasionally occur even in a British Donatia, and I must now add that Deszö, as far back as 1878, figured typical tylasters for a specimen of Donatia from Naples, identified by him as *Tethya lyncurium*. Perhaps he really had *D. japonica* before him.

Previously known Distribution. Manila (Sollas); Java Seas (Lindgren); Ceylon (Dendy); Zanzibar (Baer); Red Sea (Topsent, Row); ?Naples (Deszö). (For other possible localities *vide* Lindgren [1898] and Hentschel [1909].)

Register Nos., Localities, &c. XLVII. 2 E, XLVII. 3, XLIX., all from Praslin Reef; LIV. 2 B, Coetivy; LVII. 10 A, B, Coin, Peros; LXII., Lagoon, Diego Garcia, 8.7.05; CVII. 2, Amirante, 14.10.05, E. 17, 12—18 fathoms; CXX. 2 B, Salomon, 10—14 fathoms.

* Compare Sollas's remarks on this subject in the case of *Donatia seychellensis* [1888].

20. *Donatia ingalli* (Bowerbank).

(Plate 48, fig. 3.)

Tethea ingalli Bowerbank [1872 A].
Tethya ingalli (pars) Sollas [1888].
Tethya ingalli (pars) Lindgren [1898].
Tethya lyncurium var. *b*. Dendy [1905].
Donatia Ingalli (pars) Hentschel [1909, 1912].

This is much the commonest form of Donatia in the collection, being represented by seventeen specimens. These range in form from a flattened crust, with wide-spreading base and strongly convex upper surface (R.N. CX. 7), to the usual subspherical form with root-like processes of attachment spreading broadly over the substratum. The surface is usually more or less strongly tessellated in polygonal areas. The colour in spirit is yellowish grey. The subspherical specimens attain a diameter of about 25 mm.

The cortex is some three or four millimetres in thickness and densely charged throughout with large spherasters forming an almost solid mass.

The spicule-bundles of the main skeleton penetrate the cortex and spread out into brushes beneath the surface as usual, but there are, usually at any rate, no loose, radially arranged megascleres beneath the cortex and between the bundles.

The large spherasters (Plate 48, figs. 3 *a*, 3 *b*), when fully grown, range from about 0·08 to 0·14 mm. in diameter, with rays about half as long as the diameter of the large centrum. Though most abundant in the cortex they are often common also in the choanosome, where they may be associated with numerous much smaller forms*. Sometimes comparatively small forms, with very short rays, occur in the cortex just beneath the surface (R.N. CXIII. 1 B, fig. 3 *a*). In the larger forms the rays may occasionally branch (R.N. CXIX. 10 B).

The cortical chiaster is a typical tylaster (fig. 3 *c*) with usually more than six rays, from about 0·012 to 0·016 mm. in total diameter.

The choanosomal chiaster ranges from a typical tylaster (fig. 3 *d*) to an oxyaster or strongylaster (fig. 3 *d'*) with many short rays, which may be slightly roughened, and a total diameter of about 0·012 to 0·02 mm.

The chief distinguishing features of these specimens are the great thickness of the cortex, the close-packed arrangement of the spherasters in the cortex, and the strong tendency of the choanosomal chiasters to lose the heads of the rays and assume the form of many-rayed oxyasters.

I base my conception of this species upon Bowerbank's original description, the emended description by Sollas, and my own study of one of Bowerbank's specimens. I conclude that the "Sealark" and Ceylon specimens differ from the Australian types in the shorter rays and less strongly developed spination of the choanosomal oxyasters. As regards these spicules the typical form seems to approach *D. seychellensis*, while differing

* I have in all the species assumed that these small choanosomal forms are immature and have not included them in the range of size.

from that species in the structure of the cortex. I refrain at present from expressing any opinion as to the supposed identity of *D. robusta* and *D. cliftoni* [Bowerbank 1873 A] with this species.

Previously known Distribution. S.W. Australia (Bowerbank, Hentschel); Bass Str., Port Jackson (Sollas); Queensland (Berlin Museum; a section in my possession labelled *Tethya fissurata* Ldf. and numbered 1120); ? Java Sea and Gaspar Strait (Lindgren); Ceylon (Dendy).

Register Nos., Localities, &c. XLVII. 2 B, C, D, F, Praslin Reef; LII. 8 A, B, LIV. 1, 2 A, C, D, all from Coetivy; CX. 7, CXI. 4, 5, CXIII. 1 A, B, all from Egmont Reef; CXIX. 10 A, B, Salomon.

21. *Donatia seychellensis* (Wright).

(Plate 48, fig. 4.)

Alemo seychellensis Wright [1881].
Tethya seychellensis Sollas [1888].
Tethya seychellensis Keller [1891].
Tethya seychellensis Topsent [1893 E].
Tethya ingalli (pars) Lindgren [1898].
Tethya seychellensis Kirkpatrick [1900 A].
Tethya lyncurium var. *c.* Dendy [1905].
Donatia Ingalli Topsent [1906 B].
? *Donatia Ingalli* (pars) Hentschel [1909].
Tethya seychellensis Row [1911.]
Donatia seychellensis Dendy [1915].

This species is characterised above all by the large choanosomal oxyasters (Plate 48, fig. 4 *d*), usually with six, often branched rays. The hexradiate character of these spicules has already been pointed out by more than one writer and seems to be fairly constant. In the "Sealark" specimens the cortical and choanosomal tylasters (fig. 4 *c*, *d'*) are also typically hexradiate. The measurements of the three kinds of aster in the "Sealark" specimens are as follows:—Large spheraster (fig. 4 *a*), when fully grown, 0·07 mm.; cortical tylaster 0·012 mm.; choanosomal oxyaster (total diameter) 0·04 mm.

The three specimens in the collection have the usual subspherical form and more or less strongly tessellated surface, and all of them, in parts, show remarkably wide gaps (pore-grooves) between the tesseræ. The largest is about 25 mm. in diameter. The colour in spirit is grey or yellowish. One specimen only shows a few elongated, slender conuli (? budding).

In all three the cortex is very lacunar and does not contain nearly so many spherasters as in the specimens of *D. ingalli*, while beneath the cortex and between the radiating spicule bundles (which pierce the cortex and spread out as usual) are found numerous loose, radially arranged styli, as in *D. japonica*.

The large red Donatia so common in the neighbourhood of Port Phillip, Victoria, possesses large oxyasters very similar to those of *D. seychellensis*, but I am inclined to think, on account of other characters, that it is specifically distinct both from *D. seychellensis* and *D. ingalli*.

Previously known Distribution. Seychelles (Wright); Samboangan (Sollas); Flinders Passage, Torres Straits (Sollas); Red Sea (Keller, Row, Topsent); Okhamandal and Gulf of Manaar (Dendy); ? South West Australia (Hentschel).

Register Nos., Localities, &c. XLVII. 2 A, Praslin Reef; CXIII. 1 C, Egmont Reef; CXX. 2 A, Salomon, 10—14 fathoms.

22. *Donatia stella-grandis* n. sp.

(Plate **44**, fig. 8; Plate **48**, fig. 5.)

The single specimen (Plate **44**, fig. 8) is irregularly spherical, about 25 mm. in diameter, attached at one (evidently the lower) side to a small mass of nullipore. Part of the surface is very distinctly tessellated, the flat polygonal tesseræ being separated by wide pore-grooves; elsewhere the tesseræ are obsolete and the pore-grooves hardly discernible. There are two slight mammiform elevations on the upper surface, each of which probably bears a small vent, now closed. The colour in spirit is dull greyish yellow and the texture incompressible and of almost stony hardness.

There is nothing peculiar to notice about the arrangement of the megascleres. They radiate in stout, widely separated bundles from the interior of the sponge and penetrate the cortex. On approaching the surface these bundles spread out into brushes of spicules whose ends may project slightly beyond the surface.

The cortex is only about 0·7 mm. thick, and cortex and choanosome alike are densely packed with an almost solid mass of spherasters of various sizes.

Spicules:—(1) Styli (Plate **48**, fig. 5 *a*), tylostyli (fig. 5 *a'*) or strongyla (fig. 5 *a''*); measuring up to about 1·9 by 0·038 mm. These spicules are typically fusiform, but with the centre of the spindle much nearer to the broad end. The broad end is never much narrowed as compared with the middle of the shaft and is often distinctly tylote; the narrow end (centrifugal) may be sharply pointed or truncated.

(2) Spherasters (fig. 5 *b*); rays elongated, conical, sharp, often slightly bent, sometimes slightly and irregularly branched, about as long as the diameter of the centrum; total diameter very variable, up to about 0·25 mm. The branching of the rays seems to be confined to the larger forms, which are very numerous.

(3) Small chiasters (figs. 5 *c*, 5 *d*); with about 10 fairly stout, cylindrical rays, usually slightly roughened towards the ends, which may appear slightly tylote or simply strongylote; total diameter up to about 0·016 mm. Abundant in cortex (especially at the surface) and in choanosome.

(4) Chiasters (fig. 5 *c'*) of about the same size but with slender oxeote rays (? roughened); these seem to occur in both choanosome and cortex but are not nearly so common as the other chiasters, from which, however, they cannot be sharply separated.

This species is distinguished from all the other species of Donatia known to me, with the exception of Hentschel's *Donatia tylota* [1912], by the enormous size frequently attained by the spherasters. The largest ones are about twice the diameter of those of any other specimen in the collection, and six times the diameter of those of a specimen of *D. japonica* from Praslin (R.N. XLIX.). Bowerbank speaks of the corresponding spicules

in his *Tethea robusta* [1873 A] as being very large, but they are only one-fifth the diameter of those of the present species, according to his measurements and figure. In *Donatia tylota*, however, they seem to be nearly as large as in *D. stella-grandis*.

Register No., Locality, &c. CVI. 5, Amirante, 13.10.05, E. 16, 39 fathoms.

Family **Chondrosiidæ**.

Corticate Astrotetraxonida with complex canal system and small flagellate chambers. Without megascleres. Microscleres, when present, euasters.

This family, as at present understood, comprises only the two genera, Chondrilla and Chondrosia. These may both be regarded as reduction forms derived from some stellettid ancestor such as Aurora. The spherasters of Chondrilla closely resemble those of Aurora, but the megascleres have entirely disappeared. In some specimens of *Chondrilla mixta* the asters have already become very rare, and these seem to lead the way to the genus Chondrosia, in which all spicules have entirely disappeared.

Genus CHONDRILLA Schmidt [1862].

Chondrosiidæ with microscleres (euasters of one or more kinds).

23. *Chondrilla australiensis* Carter.

(Plate **48**, fig. 6.)

Chondrilla australiensis Carter [1873 c].
Chondrilla australiensis Lendenfeld [1886 A].
Chondrilla australiensis Lindgren [1897, 1898].
Chondrilla australiensis Dendy [1905, 1915].
Chondrilla australiensis Hentschel [1909, 1912].

This species is characterised by the presence of two kinds of aster, spherasters (Plate **48**, fig. 6 *a*) about 0·03 mm. in diameter, and oxyasters (fig. 6 *b*) of somewhat smaller size with roughened and sometimes slightly branched rays. The spherasters are characteristically cortical in distribution and the oxyasters characteristically choanosomal, but spherasters occur also in the choanosome and oxyasters in the cortex.

It seems possible also that the light colour as compared with some other species may be a more or less constant character. Carter originally described the species as "of a dirty yellow or buff colour." Lendenfeld copies this. Hentschel speaks of the colour of specimens from S.W. Australia as mostly clear greyish-yellow, almost white in some small specimens, but in places brown to black-brown. The Ceylon specimens collected by Prof. Herdman were of a greyish colour (in spirit). The "Sealark" specimens range from almost quite white all over (R.N. XLIII. 2) to light brown (in spirit); they form flattened or lobular crusts of the usual appearance. R.N. XXXI. 1 is growing upon a specimen of *Dercitopsis minor*.

In some specimens (R.N. XLIII. 2, 4) the oxyasters are so nearly smooth as to resemble very closely those of *C. mixta*.

Previously known Distribution. Port Jackson, E. Coast of Australia (Carter, Lendenfeld); Shark's Bay, S.W. Australia (Hentschel); Okhamandal and Ceylon (Dendy); coast of Cochin China (Lindgren); Aru Islands (Hentschel).

Register Nos., Localities, &c. XXXIII. 1, 3, XLIII. 2, 4, all from Cargados Carajos, 30.8.05, B. 13, 30 fathoms; LXXXVII., Amirante, 9.10.05, E. 6, 28 fathoms; CXXXV. 2, Seychelles, 13.10.05, F. 9, 37 fathoms.

24. *Chondrilla mixta* Schulze.

(Plate 48, fig. 7.)

Chondrilla mixta Schulze [1877 c].
? Chondrilla mixta Ridley [1884 c].
Chondrilla mixta Lindgren [1897, 1898].
Chondrilla mixta Kirkpatrick [1900 B].

This species was described by Schulze from the Red Sea. Schulze had only a single specimen, of which he observes "Dasselbe stellte eine blassgraue, braungefleckte Kruste von 2—4 Mm. Dicke mit unregelmässig welliger aber glatter Oberfläche dar."

The "Sealark" specimens are for the most part dark brown or nearly black on the surface, owing to the strong development of pigment-granules in and beneath the cortex.

The spicules are by no means numerous and in some specimens almost disappear from the cortex, so that it is hard to find anything but the choanosomal oxyasters.

The characteristically cortical spherasters (Plate 48, fig. 7 *a*) resemble those of *C. australiensis* and measure about 0·03 mm. in diameter. The choanosomal oxyasters (fig. 7 *b*) are of about the same size or a little smaller. They differ from those of *C. australiensis* in having smooth, unbranched rays. Apart from the possible difference in colour this seems to be the only feature that distinguishes the two species, and it may well be doubted whether the two are more than varietally distinct.

The specimen described by Ridley from the Amirante group was of a pale brown or buff colour and had oxyasters frequently with branched rays; it was probably *C. australiensis*.

Two specimens described by Lindgren from Java and Gaspar Straits were blue-black on the outside with a finely granulated surface due to the presence of very minute papillæ.

Previously known Distribution. Red Sea (Schulze); Java and Gaspar Straits (Lindgren); Funafuti Atoll (Kirkpatrick).

Register Nos., Localities, &c. LIII. 8, Coetivy; LVII. 1, Coin, Peros; CX. 4, CXIII. 3, 9, Egmont Reef; CXII. 2, 4, Egmont Lagoon; CXX. 6, Salomon, 10—14 fathoms.

25. *Chondrilla sacciformis* Carter.

(Plate 48, fig. 8.)

Chondrilla sacciformis Carter [1879 B].
Magog sacciformis Sollas [1888].
Chondrilla grandistellata Thiele [1900].

The single specimen in the collection forms an elongated, slug-shaped crust, about 30 mm. in length, 10 mm. in greatest breadth and 6 mm. in greatest thickness. The margins are strongly incurved towards the base of attachment, probably owing to contraction after removal from the substratum. There are five or six minute, contracted vents, scattered singly, each on a small mammiform projection on the upper surface. The

texture is hard and tough. The colour of the upper surface is rather dark brown, internally much paler, with, to the naked eye, a sharp boundary line between cortex and choanosome. Under a pocket-lens the huge spherasters can be distinctly seen both on the surface and in the interior (when cut); they give the surface a characteristically harsh feel.

The cortex is about 0·3 mm. thick and contains a great many of the large spherasters, for the most part arranged in a single layer at the surface. It is fibrous, and around the spherasters the fibres are concentrically arranged. The dark brown pigment granules are most abundant in the outermost part of the choanosome, just beneath the cortex, but occur also both in the choanosome below and in the cortex above this layer. Numerous narrow inhalant canals (pore-canals) penetrate the cortex vertically, each starting above from a single dermal pore. These canals are rendered conspicuous by the numerous pigment granules that accompany them. Probably they unite in groups on their way through the cortex as in other species of Chondrilla.

The skeleton consists of spherasters (Plate **48**, figs. 8 *a*, 8 *b*, 8 *c*) only, varying much in size and in the shape of the rays. They are abundantly scattered in the choanosome as well as in the cortex. The fully grown ones, measuring about 0·14 mm. in diameter, are by far the most abundant. There appears to be no difference between the cortical and choanosomal spicules, much the same range of variations occurring in both situations. The small ones are probably young forms; I have measured one with a diameter of no more than about 0·04 mm.; they have very numerous, simple, smooth, conical rays, springing from an enormous centrum, the rays only about 0·004 mm. long. The large ones are of two principal kinds, with intermediates:—(1) with sharp-pointed conical rays, somewhat inflated towards the base; often slightly roughened except for the tips of the rays (fig. 8 *a*); (2) with the rays truncated and roughened at the ends (fig. 8 *b*), or even reduced to short, subcylindrical projections with roughened ends (fig. 8 *c*). The intermediate forms show all degrees of truncation and roughening of the rays*.

I have already, in discussing the genus Aurora†, given my reasons for believing that Carter's *Chondrilla sacciformis* is a true Chondrilla, and I need not repeat them here. The examination of a type specimen in his cabinet has convinced me that the "Sealark" specimen is specifically identical, and there appears little doubt that this is also the case with Thiele's *Chondrilla grandistellata*. I hardly know what Thiele means by the statement that a distinctly differentiated cortex is not present in his specimens. At the same time it is true that the line of demarcation between cortex and choanosome is by no means everywhere clearly defined in mine, possibly owing to the indifferent histological condition of the material.

The enormous size of the spherasters is very remarkable in comparison with such species as *C. australiensis*, *C. mixta*, &c.

Previously known Distribution. Mauritius (Carter); Ternate (Thiele).

Register No., Locality, &c. XI. 4, Saya de Malha, 7.9.05, C. 19, 29 fathoms.

* The form represented in Fig. 8 *c* is probably alone fully grown, all the others being developmental stages.

† *Vide* p. 245.

DESCRIPTION OF PLATES

Plate 44.

(On specially toned paper.)

Fig. 1. *Dercitopsis minor* n. sp. R.N. XLII. 6. Nat. size.
Fig. 2. *Yodomia perfecta* n. sp. R.N. X. 1. Nat. size.
Fig. 2 *a*. *Yodomia perfecta* n. sp. R.N. VI. Nat. size.
Fig. 3. *Myriastra cavernosa* n. sp. R.N. VII. 5 A. Nat. size.
Fig. 3 *a*. *Myriastra cavernosa* n. sp. R.N. VII. 5 B. Cut surface of divided specimen. Nat. size.
Fig. 4. *Aurora cribriporosa* n. sp. R.N. CXIX. 12. Seen from above. Nat. size.
Fig. 5. *Aurora rowi* n. sp. R.N. CXXXI. Nat. size.
Fig. 6. *Ecionemia laviniensis* Dendy. R.N. XI. 2. Nat. size.
Fig. 7. *Rhabdodragma conulosa* (Kieschnick). R.N. LXXVIII. 1 A. Nat. size.
Fig. 8. *Donatia stella-grandis* n. sp. R.N. CVI. 5. Nat. size.

Plate 45.

Fig. 1. *Dercitopsis minor* n. sp. R.N. CXI. 7.
1 *a*. Calthrops; 1 *b*. triods; 1 *c*. oxea; all × 330.
Fig. 2. *Pachastrella tenuilaminaris* (Sollas). R.N. LXXII. 2.
2 *a*. Calthrops and short-shafted triænes, × 60; 2 *b*. oxea, × 60; 2 *c*. style, × 60; 2 *d*. strongyle, × 60; 2 *e*. hair-like oxea, × 60; 2 *f*. metasters, × 550; 2 *g*. microxeote, × 550.
Fig. 3. *Yodomia perfecta* n. sp.
3 *a*. R.N. X. 1, calthrops, × 60; 3 *a'*. R.N. IX. 1, calthrops, × 60; 3 *a''*. R.N. IX. 1, reduced calthrops, × 60; 3 *b*. R.N. X. 1, small calthrops, × 60; 3 *b'*. R.N. IX. 1, small calthrops, × 60; 3 *c*. R.N. X. 1, mesotriænes, × 60; 3 *c'*. R.N. IX. 1, mesotriænes, × 60; 3 *c''*. R.N. VI., mesotriænes, × 60; 3 *d*. R.N. X. 1, oxeote, × 60; 3 *e*. R.N. VI., amphiasters, × 550; 3 *f*. R.N. VI., smooth microrhabds, × 550; 3 *g*. R.N. VI., spined microrhabds, × 550.

Plate 46.

Fig. 1. *Myriastra cavernosa* n. sp. R.N. VII. 5.
1 *a*. Orthotriænes, × 60; 1 *b*. oxea, × 60; 1 *c*. small oxeote, × 550; 1 *d*. chiasters, × 550.
Fig. 2. *Aurora providentiæ* n. sp. R.N. LXXXVI. 2.
2 *a*. Orthotriænes, × 60; 2 *b*. anatriæne, × 60; 2 *b'*. cladome of anatriæne, × 770; 2 *b''*. cladome end of reduced anatriæne, × 770; 2 *c*. oxea, × 60; 2 *c'*. small oxeote, × 770; 2 *d*. large spheraster, × 770; 2 *e*. small spheraster, × 770; 2 *f*. oxyasters, × 770.
Fig. 3. *Aurora cribriporosa* n. sp. R.N. CXIX. 12.
3 *a*. Oxea, × 60; 3 *b*. large spheraster, × 770; 3 *c*. young spheraster(?), × 770; 3 *d*. minute spheraster, × 770; 3 *e*. oxyaster, × 770.
Fig. 4. *Aurora rowi* n. sp. R.N. CXXXI.
4 *a*. Orthotriænes, × 60; 4 *b*. oxeote, × 60; 4 *c*. sterrospheraster, × 770; 4 *d*—4 *h*. stages in the development of the sterrospheraster, × 770; 4 *j*. small, irregular spherasters, × 770; 4 *k*. oxyasters, × 770.
Fig. 5. *Ecionemia laviniensis* Dendy. R.N. XI. 2.
5 *a*. Dichotriænes, × 60; 5 *a'*. cladome of dichotriæne, × 60; 5 *b*. anatriæne, × 770; 5 *c*. oxea, × 60; 5 *d*. chiasters, × 770; 5 *e*. oxyasters, × 770; 5 *f*. intermediate forms between oxyasters and chiasters, × 770; 5 *g*. microstrongylote, × 770.
Fig. 6. *Asteropus simplex* (Carter) R.N. LXXVIII. 2.
6 *a*. Oxea, × 60; 6 *a'*. style, × 60; 6 *b*. oxyasters, × 770; 6 *c*. sanidasters, × 770.
Fig. 7. *Dragmastra lactea* (Carter) var. *mauritiana* nov. R.N. CXXVI. 4 E.
7 *a*. Dichotriænes, × 60; 7 *b*. oxea, × 60; 7 *c*. small oxyspherasters, × 770; 7 *d*. larger oxyspheraster, × 770; 7 *e*. trichodragmata, × 770.

Plate 47.

Fig. 1. *Rhabdodragma conulosa* (Kieschnick). R.N. LXXVIII. 1.

1 *a*. Plagiotriænes, × 60; 1 *b*. oxea, × 60; 1 *c*. chiasters, × 770; 1 *d*. small oxeote, × 770; 1 *e*. microrhabds, × 770; 1 *f*. trichodragmata, × 770.

Fig. 2. *Jaspis johnstonii* (Schmidt). R.N. LXXVIII. 11.

2 *a*. Oxea, × 60; 2 *a'*. stylote form, × 60; 2 *b*. microxea, × 770; 2 *c*. oxyasters, × 770.

Fig. 3. *Geodia auroristella* n. sp. R.N. LXXXVI. 1.

3 *a*. Orthotriænes, × 60; 3 *b*. anatriæne, × 60; 3 *c*. oxeote, × 60; 3 *c'*. style, × 60; 3 *c''*. strongylote, × 60; 3 *d*. sterraster, × 310; 3 *d'*—3 *d'''*. developmental stages of sterraster, × 310; 3 *d''''*. portion of surface of late developmental stage of sterraster, × 310; 3 *e*. smooth spheraster, × 770; 3 *f*. spined spheraster, × 770; 3 *g*. minute spheraster or chiaster, × 770; 3 *h*. oxyaster, × 770.

Fig. 4. *Erylus lendenfeldi* Sollas. R.N. CII. 2.

4 *a*. Orthotriæne, × 60; 4 *b*. oxea, × 60; 4 *c*. aspidasters, × 310; 4 *c'*—4 *c'''*. developmental stages of aspidaster, × 310; 4 *c''''*. marginal portion of surface of aspidaster, × 770; 4 *d*. large oxyaster, × 770; 4 *e*. small oxyasters, × 770; 4 *f*. polyactinose oxyaster, × 770; 4 *g*. microrhabds, × 770.

Fig. 5. *Erylus proximus* n. sp. R.N. LXXVII. 7.

5 *a*. Short-shafted triænes, × 60; 5 *b*. oxea, × 60; 5 *b'*. style, × 60; 5 *b''*. strongylote, × 60; 5 *c*. aspidasters, × 310; 5 *c'*—5 *c''''*. developmental stages of aspidaster, × 310; 5 *c'''''*. marginal portion of surface of aspidaster, × 770; 5 *d*. chiasters, × 770; 5 *e*. microrhabds, × 770.

Plate 48.

Fig. 1. *Donatia lyncurium* auctorum. R.N. CXX. 2 C.

1 *a*. Spherasters from cortex, × 310; 1 *b*. spherasters from choanosome, × 310; 1 *c*. chiasters from cortex, × 770; 1 *d*. chiasters (oxyasters) from choanosome, × 770.

Fig. 2. *Donatia japonica* (Sollas). R.N. LVII. 10 B.

2 *a*. Spheraster from cortex, × 310; 2 *b*. spherasters from choanosome, × 310; 2 *c*. tylasters from cortex, × 770; 2 *d*. tylasters from choanosome, × 770; 2 *e*. strongylaster from choanosome, × 770.

Fig. 3. *Donatia ingalli* (Bowerbank). R.N. CXIII. 1 B.

3 *a*. Spherasters from cortex, × 310; 3 *b*. spherasters from choanosome, × 310; 3 *c*. tylasters from cortex, × 770; 3 *d*. tylaster from choanosome, × 770; 3 *d'*. strongylasters from choanosome, × 770.

Fig. 4. *Donatia seychellensis* (Wright). R.N. CXX. 2 A.

4 *a*. Spherasters from cortex, × 310; 4 *b*. spherasters from choanosome, × 310; 4 *c*. tylasters from cortex, × 770; 4 *d*. oxyasters from choanosome, × 770; 4 *d'*. tylasters from choanosome, × 770.

Fig. 5. *Donatia stella-grandis* n. sp. R.N. CVI. 5.

5 *a*. Styli, × 60; 5 *a'*. tylostyli, × 60; 5 *a''*. strongyle, × 60; 5 *b*. spherasters, × 310; 5 *c*. cortical chiasters, × 770; 5 *c'*. slender-rayed chiaster, × 770; 5 *d*. choanosomal chiasters, × 770.

Fig. 6. *Chondrilla australiensis* Carter. R.N. XXXIII. 3.

6 *a*. Spheraster from cortex, × 550; 6 *b*. oxyasters from choanosome, × 550.

Fig. 7. *Chondrilla mixta* Schulze. R.N. CX. 4.

7 *a*. Spheraster from cortex, × 550; 7 *b*. oxyasters from choanosome, × 550.

Fig. 8. *Chondrilla sacciformis* Carter. R.N. XI. 4.

8 *a*—8 *c*. Spherasters, showing variation in shape of rays, × 550. (8 *a* and 8 *b* are probably developmental stages of 8 *c*.)

4

5

3

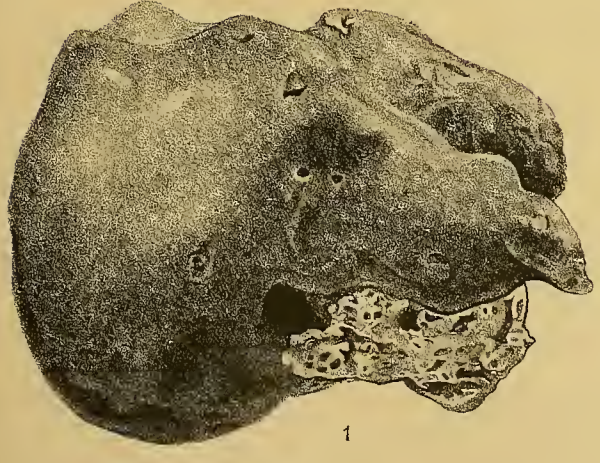
2

3a

8

2a

6



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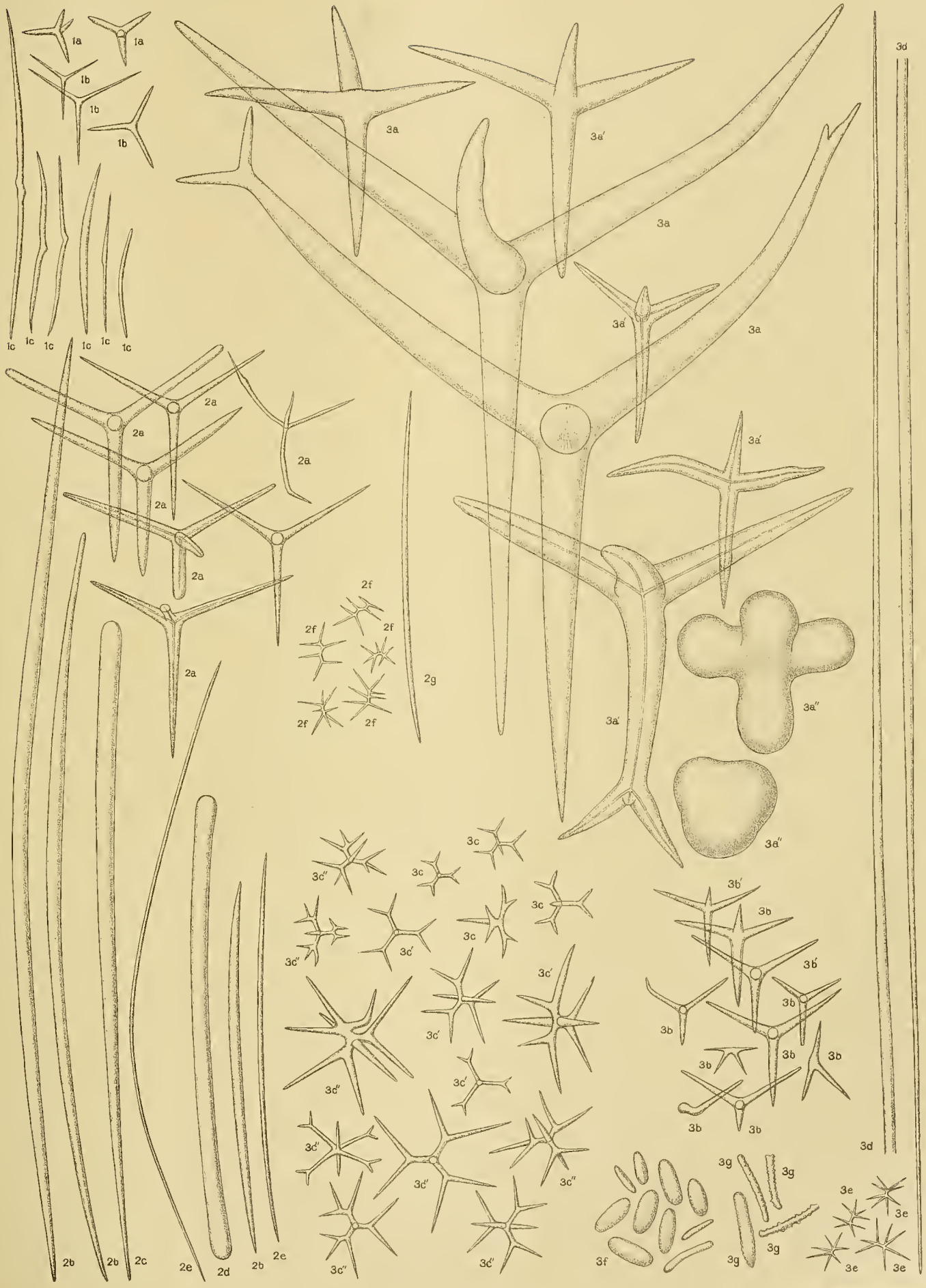

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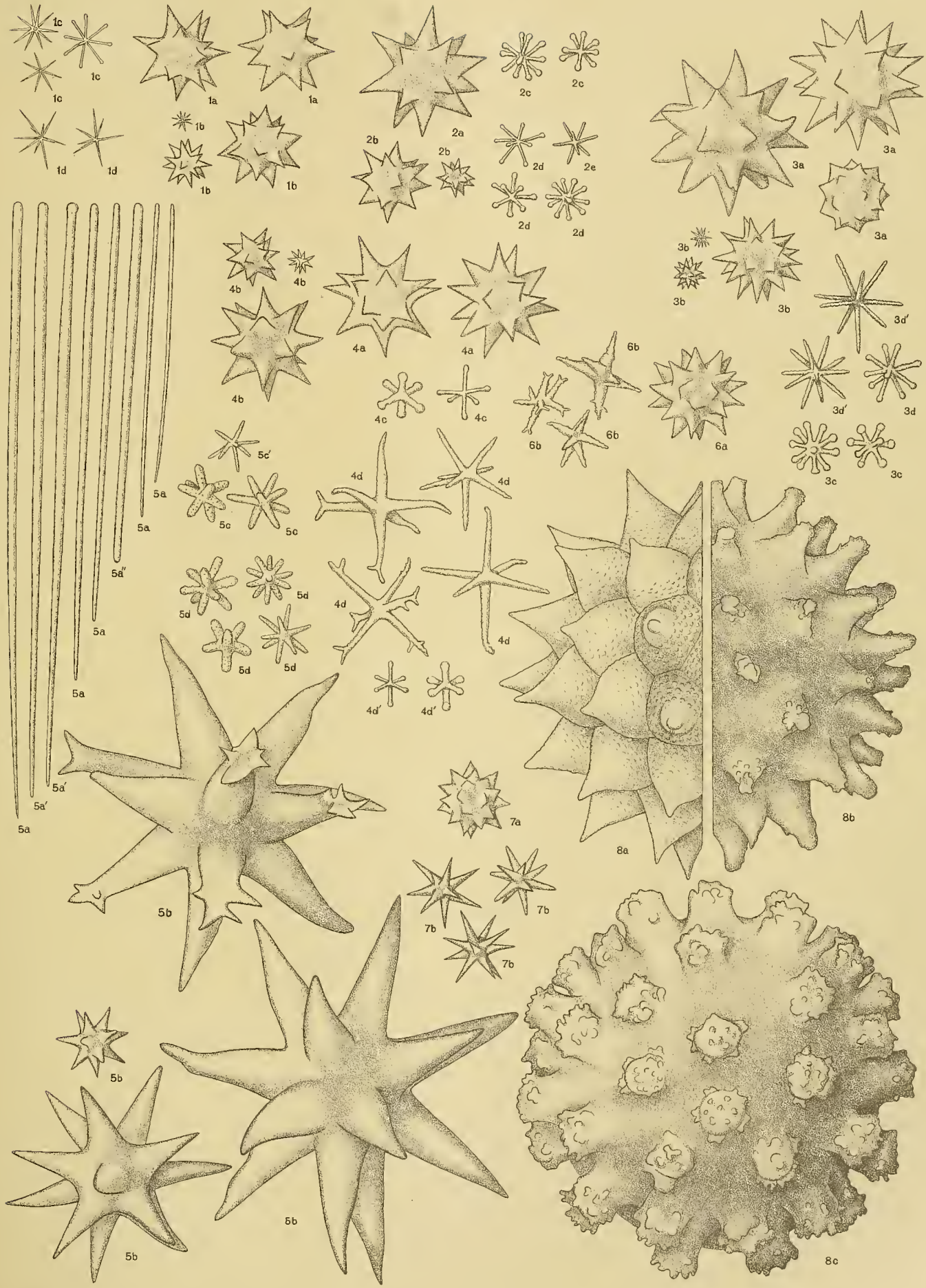

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SEALARK TETRAXONIDA.

No. VII.—RHYNCHOTA. PART II: SUBORDER HOMOPTERA.

By Wm. Lucas Distant.

(Communicated by J. Stanley Gardiner, M.A., F.R.S., F.L.S.)

(With Plates 49—51.)

Read 1st June, 1916.

In my previous communication (1913) devoted to the Heteroptera, I was able to enumerate 139 species; in this Homopterous section 98 species are detailed, bringing up the number of the Seychelles Rhynchota to 237 species. These may again be augmented by referring to the first collection made by Prof. Gardiner and detailed in these Transactions (1909) in which 3 species of Heteroptera and 3 species of Homoptera were included which are not contained in the present collection; and these bring up the total number of species brought home by the two expeditions to 243 species. A few others (Heteroptera) have been enumerated and described by Reuter and Bergroth which have not been found by either Prof. Gardiner or Mr Scott; a reference to these papers will be found in the Bibliography further on.

The Homoptera, especially the smaller forms, are now being assiduously worked by such good Homopterists as Melichar, Matsumura and Muir, but even with these advantages the material from many large areas is so scanty that little comparison in distributional aspects is possible. Of the 98 species of Homoptera contained in this collection no fewer than 82 have been regarded as undescribed and have compelled the erection of 26 new genera to contain them. It would consequently be futile to consider that all or a very considerable portion of these new species are peculiar to the Seychelles, and it is even more improbable that the new genera should be confined to these islands.

With the Homoptera however a few distributional peculiarities cannot be ignored. The large family Cicadidæ is only represented by two species, one of which is also found in, and was described from, Madagascar. The Hawaiian fauna is reported as without a representative. The family Fulgoridæ is poorly represented; neither the subfamilies Fulgorinæ nor Eurybrachydinæ are represented in these collections, and the Dictyophorinæ, Tropiduchinæ and Achilinæ are each represented by one genus and one species only. Not a single Membracid was found, and the Membracidæ appear to be equally absent from the Hawaiian Archipelago. The family Cercopidæ is only represented by one species and that belonging to the subfamily Aphrophorinæ.

It is at present impossible to compare the homopterous relationship of Madagascar and the Mascarene Islands with the similar fauna of the Seychelles, for the first is still practically unworked and unrecorded except in the larger and more conspicuous features, nor judging from the conclusions of other entomologists who have worked out different groups of insects is such a relationship likely to be pronounced. After working out a very large portion of the homopterous fauna of British India, I strongly incline to the view that it is in that and adjoining regions that the Seychellian Homoptera find their nearest relationship, though it is not a close one, qualified but evident. The material does not at present exist for a detailed comparison.

BIBLIOGRAPHY

Walker, Fras. Descriptions of a few species scattered throughout the Catalogues of Heteroptera and Homoptera published by the Trustees of the British Museum, 1850—1873. The specimens were presented by Prof. Percival Wright, and some are labelled "Round Island."

E. Bergroth and O. M. Reuter. "Mission Scientifique de M. Ch. Alland aux îles Seychelles, Hétéroptères." Rev. d'Entomol. xii. pp. 197—209 (1893).

Linell, Martin L. "On the insects collected by Dr Abbot on the Seychelles, Aldabra, Gloriosa and Providence Islands." Proc. U.S. Nat. Mus. xix. pp. 695—706 (1897). References to the Rhynchota very few.

Voeltzkow, Alfred. "Die von Aldabra bis jetzt bekannte Flora und Fauna." Abhandl. Senckenb. Nat. Ges. xxvi. pp. 541—565 (1902). In this publication is (p. 561) a list of 20 species of Heteroptera, of which Dr Bergroth has written to inform me that he gave the list of "18," probably an error for "20," some of which in the "Gerridæ" are ascribed to a genus "Telmaliæa," of which I can find neither reference nor description. Dr Voeltzkow also refers to a paper by the same writer in the same publication (Bd. xxvii), of which I can find no trace.

Distant, W. L. "Sealark" Rhynchota. Trans. Linn. Soc., ser. 2, Zool., vol. xiii. pp. 29—47, Pl. 4 (1909).

—— "Rhynchota," Part I, Subord. Heteroptera. Trans. Linn. Soc., ser. 2, Zool., vol. xvi. pp. 139—191, Pls. 11—13 (1913).

Order Rhynchota.

Suborder Homoptera.

Family **Cicadidæ**.

Only two species of this family have been received from the Seychelles and possibly they are the only representatives of the family in these islands. Martin L. Linell*, writing on the "Insects from Gloriosa Island," mentions "a large *Cicada* closely allied to the South African *Platypleura limbata* Fabr." which is doubtless the *Yanga seychellensis* Dist., enumerated in the present paper. Another species which he mentions† as "very much resembling *Tettigia orni* from Europe, but smaller, is

* Proc. U. S. Nat. Mus. xix. p. 702 (1897).

† *Loc. cit.* p. 696.

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without doubt *Cicada pulverulenta* Dist. The latter of these species is found in, and was described from, Madagascar. Although Madagascar is richly represented in this family, we are only enabled to record two species from the Seychelles. At present however the Hawaiian fauna is without a representative, and this is the status of many other of the smaller islands in the Seychelles region.

Subfamily **Cicadinæ**.

140. *Yanga seychellensis.*

Yanga seychellensis Dist., Gen. Insect. Fasc. 142, p. 13 (1912); Trans. Linn. Soc. London, Zool. xvi. Pl. 11, fig. 22 *a*, *b* (1913).

Yanga andriana Dist., Trans. Linn. Soc. London, Zool. xiii. p. 41 (1909).

Loc. Seychelles. Praslin. Mahé: from near Morne Blanc, Cascade Estate (E. G. B. Meade-Waldo).

I originally recorded this species as *Y. andriana* from an examination of two or three discoloured specimens (supra, 1909), but subsequently Mr Scott supplied a number of fresh examples which proved the species to be a distinct one. A pupa-case, evidently of this species, is labelled "Silhouette." Mr Meade-Waldo took this species at light.

141. *Cicada pulverulenta.*

Cicada pulverulenta Dist., Trans. Ent. Soc. London, 1905, p. 199; Trans. Linn. Soc. London, Zool. xiii. p. 41, Pl. 4, fig. 8 *a*, *b* (1909).

Loc. Seychelles. Mahé: from near Morne Blanc and from Cascade Estate, both about 800 feet, and other localities, 1905 and 1908—9: frequently attracted by light. Aldabra, 1908—9 (Fryer), Madagascar.

Family **Fulgoridæ**.

This family is not well represented in the Seychelles. Neither of the subfamilies Fulgorinæ nor Eurybrachydinæ are found in this collection, and all that can be enumerated are moderately small and obscure species. The subfamilies Dictyophorinæ, Tropiduchinæ and Achilinæ are each represented by one genus and one species only.

Subfamily **Dictyophorinæ**.

Only one genus, here described as new, can be included in this subfamily. The genus *Dictyophora* so widely distributed is unrepresented in the collection.

Aselgeoides, gen. nov.

Head produced, elongate, sulcate, eyes elongate, compressed; face elongate, centrally and laterally carinate, apex narrowed, widened to the area of the eyes and then obliquely narrowed to base of clypeus which is centrally carinate; rostrum passing the posterior coxæ; pronotum short, posterior margin obliquely concave; mesonotum tricarinate; posterior tibiæ with two spines, one before and the other

beyond middle, first joint of posterior tarsi longer than the other two joints together, tegmina about two and a half times as long as broad, the apical margin rounded, veins mostly longitudinal, transverse veins very few, costal margin slightly depressed at stigma; wings broader than tegmina, a few transverse veins on apical half.

Allied to *Aselgeia* Walk.

142. *Aselgeoides insularis*, sp. n. (Plate **49**, figs. 1, 1 *a*).

Head, thorax and abdomen ochraceous, apical area of abdomen more or less testaceous; legs flavescent; tegmina subhyaline, the veins closely spotted with fuscous, the stigma fuscous, anteriorly ochraceous, wings pale fuliginous, the veins darker; structural characters as in generic diagnosis.

Long. excl. tegm. 6 mm. Exp. tegm. 12 mm.

Loc. Seychelles. Silhouette: near Mont Pot-à-eau, over 1000 feet; marshy plateau of Mare aux Cochons, about 1000 feet, and from forest above. Mahé: from near Morne Blanc; country above Port Glaud, about 500—1000 feet; forest above Cascade Estate, 1000 feet; from stunted forest vegetation on summit of Mount Sebert, circa 2000 feet; high damp forest at summit of Morne Pilot, over 2000 feet.

Subfamily **Cixiinæ**.

Of this abundant subfamily seven genera are here enumerated, only two of which were previously known, and five are proposed as new. It is noteworthy that neither of the somewhat universally distributed genera, *Oliarus* and *Cixius*, is included in this collection; *Brixia* however, another widely spread genus, is found in the Seychelles.

Genus Caneirona*.

Caneirona Dist., Faun. Brit. Ind. Rhynchota, vol. vi. p. 38 (1916).

Vertex about as broad as long, the lateral margins strongly carinate, the anterior margin with a short central spine, the anterior lateral angles also shortly spinous and distinctly extending beyond eyes; face longer than greatest breadth, widened behind eyes towards clypeus, anterior margin more or less truncate, posterior margin angularly concave with an ocellus on each side, the lateral margins reflexed, centrally strongly, longitudinally ridged; clypeus much shorter than face, centrally ridged, laterally reflexed; rostrum long, passing the posterior coxæ; pronotum very short, posteriorly angularly concave; mesonotum about twice as long as vertex and pronotum together, tricarinate; abdomen moderately robust; tegmina twice as long as greatest breadth, gradually widened towards apex, costal margin distinctly waved, apices rounded, claval vein not reaching apex, apical areas distinctly delineated; wings shorter than tegmina, the broadest areas of each about equal in width, discally shortly transversely veined; posterior tibiæ unarmed.

Caneirona is allied to *Commolenda* Dist., at present only known from Ceylon.

* This genus is named after Nicolas Caneïrio on whose charts the Seychelles appeared in 1502. Since this description was written a second species, *C. indica* Dist., has been received from S. India and is described in the Faun. Brit. Ind. Rhynchota, vol. vi. p. 39, fig. 24 (1916).

143. *Caneirona maculipennis*, sp. n. (Plate **49**, fig. 9 *a*).

Body and legs ochraceous, paler beneath than above, abdomen sometimes distinctly sanguineous; mesonotum with the disk pale ochraceous, the lateral areas much darker; tegmina subhyaline, the margins very narrowly ochraceous, with numerous small black spots, usually arranged about four near base, two near extremity of claval area, three in transverse series beyond middle, and a waved series near bases of apical areas; wings hyaline, the veins darker; structural characters as in generic diagnosis.

Long. excl. tegm. 4½ mm. Exp. tegm. 11 mm.

Loc. Seychelles. Mahé: Cascade Estate, forest, above 1000 feet; high forest near Morne Blanc. Silhouette: from near Mont Pot-à-eau, and from Mare aux Cochons. Praslin: Côtes d'Or Estate, from Coco-de-Mer forest in the Vallée de Mai.

Clusivius, gen. nov.

Vertex of head about as long as broad, centrally and laterally strongly carinate, distinctly projecting beyond eyes, the central carination slightly anteriorly acutely produced; antennæ slender and inconspicuous; face longer than broad, centrally and laterally carinate, the anterior margin undulate between the apices of the carinations, two small ocelli at posterior margin; clypeus short, globose, about one-third the length of face, faintly centrally carinate; pronotum tricarinate, a little shorter than head; mesonotum tricarinate, slightly longer than head and pronotum together; posterior tibiæ unarmed; tegmina more than twice as long as broad, narrower at base, distinctly broadened towards apical area, costal margin slightly convex, apical margin strongly convexly rounded, claval margin a little posteriorly produced, veins longitudinal, a few short oblique transverse veins on apical costal area, an oblique transverse series of veins on subapical area, and an imperfect series of same a little beyond middle; wings long, only a little shorter than tegmina, two transverse veins beyond middle, one on costal area, the other on disk.

144. *Clusivius spectabilis*, sp. n. (Plate **49**, fig. 15 *a*).

Head, pronotum and mesonotum black, the latter with a pale ochraceous curved fascia occupying the lateral and subposterior margins; abdomen testaceous, the segmental margins darker; head beneath, sternum and legs pale ochraceous; face with broad anterior and posterior fasciæ, anterior and intermediate tibiæ and tarsi, and apices of posterior tibiæ and tarsi, black; tegmina dark shining fuscous, the claval area and a large costal stigmatal spot, pale ochraceous; wings fuliginous, with an oblique subapical greyish line beyond middle, commencing about middle of disk and terminating on posterior margin; structural characters as in generic diagnosis.

Long. excl. tegm. 4 mm. Exp. tegm. 7 mm.

Loc. Seychelles. Silhouette: from about 1500 feet, forest above Mare aux Cochons. Mahé: from grass in cultivated country, about 1000 feet; Cascade Estate, forest, 1000—2000 feet.

Matutinus, gen. nov.

Vertex of head a little longer than broad, somewhat narrow, concave, a little broader at base than at apex, the lateral margins strongly carinate, the apex triangulate; antennæ with the first and second joints robust; face very much longer than broad, centrally and laterally strongly carinate, the central carination prominent at apex, two small ocelli on posterior margin; clypeus nearly half the length of face, centrally carinate; pronotum a little shorter than head, tricarinate; mesonotum slightly longer than head and pronotum together, tricarinate, the disk longitudinally flattened; tegmina more than twice as broad as long, the veins few and longitudinal, obliquely triangulate beyond middle, the costal membrane broad; wings considerably broader than tegmina*; posterior tibiæ unarmed.

145. *Matutinus opulentus*, sp. n. (Plate **49**, fig. 16 *a*).

Body above black; vertex of head (excluding lateral margins), and a central fascia to pro- and mesonota, pale ochraceous; basal area of abdomen pale testaceous; body beneath imperfectly seen in the unique carded type; face black; antennæ ochraceous; tegmina faintly ochraceous, claval area paler with a dark fuscous spot at apex, the apical area somewhat broadly dark fuscous, this coloration angulated on its inner margin, before apex a large ill-defined whitish spot on costal margin, a similar but smaller spot near apex of inner margin; wings very pale fuliginous, their apices (excluding an upper apical pale spot) fuliginous†.

Long. excl. tegm. 3 mm. Exp. tegm. 8 mm.

Loc. Seychelles. Mahé: marshes on coastal plain at Anse aux Pins and Anse Royale, i. 1909.

Adolendana, gen. nov.

Vertex long, produced in front of eyes, the margins very strongly ridged, the disk being thus longitudinally concave, apex triangulate, base strongly concave; face elongate, narrow from apex to region of eyes and then ampliated and again a little obliquely narrowed to base of clypeus, before which there are two small ocelli, the lateral margins strongly ridged and centrally longitudinally carinate; apex truncate; clypeus about half the length of face, laterally ridged and centrally carinate; pronotum very short, anteriorly conically produced; mesonotum large, a little longer than head and pronotum together, longitudinally tricarinate; abdomen somewhat laterally compressed; posterior tibiæ without spines; tegmina somewhat narrow at base, ampliately widened towards apex which is rounded, the base of costal margin distinctly gibbous, costal membrane wider at apex than at base, apical cells elongate and distinctly

* Since the unique type was figured and before the description was written, the wings were unfortunately mutilated in an attempt to reset the carded specimen. The peculiar venation of the wings therefore rests on the accuracy of a painstaking and accurate artist.

† Cf. note to generic description.

deliminated, a distinct stigmatical spot; wings shorter than tegmina but broader, transversely veined on upper disk.

Allied to *Brixia* Stål.

146. *Adolendana typica*, sp. n. (Plate **49**, fig. 10 *a*).

Body and legs fuscous-brown, lateral areas of the mesonotum very dark castaneous; tegmina pale fuliginous, the veins darker, two small spots near base, a transverse fascia—bifurcating posteriorly—before middle, and the apical area, more or less, fuscous-brown, containing some small greyish-white spots, stigmatal spot dark castaneous, more or less margined with greyish-white; wings pale fuliginous; structural characters as in generic diagnosis.

Long. excl. tegm. $3\frac{1}{2}$ mm. Exp. tegm. $11\frac{1}{2}$ to 12 mm.

Loc. Seychelles. Silhouette: near Mont Pot-à-eau, all over 1000 feet; Mare aux Cochons, plateau and forest above. Mahé: country above Port Glaud, about 500—1000 feet; high forest of Morne Blanc and Pilot; top of Mount Sebert, nearly 2000 feet; forest above Cascade Estate; Mare aux Cochons district, from forest of rather stunted Capucin trees (*Northea*) on summit of "Montagne Anse Major," 2000 feet or over.

Volcanalia, gen. nov.

Vertex of head very narrow, appearing more as a longitudinal furrow between the eyes, the margins carinately reflexed, scarcely or distinctly projecting in front of eyes; antennæ very slender; face about as long or a little longer than broad, its apex truncate or more or less emarginate, narrowed anteriorly, the lateral margins either more or less convex, or oblique, centrally strongly carinate, laterally with the margins more or less carinate, clypeus broad, varying in length either about as long, or a little longer or shorter than face, centrally carinate; tegmina considerably more than twice as long as broad, the veins longitudinal to apical area where they are above and beneath shortly oblique, and medially and between them there are two or three straight longitudinal veins, the veins are also more or less setigerous; wings considerably broader than tegmina, the posterior margin undulate towards the anal area; posterior tibiæ without spines; two small, more or less distinct ocelli at basal margin of face.

Type. *V. typica* Dist.

Volcanalia may be placed near *Haplaxius* Fowler, from Central America.

The members of the genus are all forest species, found sitting on palm leaves, &c. (Hugh Scott).

147. *Volcanalia typica*, sp. n. (Plate **49**, fig. 13 *a*).

Head, pronotum, mesonotum and apical half of abdomen, black, basal half of abdomen brownish-ochraceous; head beneath and sternum black, legs brownish-ochraceous; tegmina blackish-brown, two costal stigmatal spots, the innermost largest, and an

opposite spot on inner margin, creamy-white; wings fuliginous with a pale longitudinal suffusion; face slightly shorter than clypeus, its apical margin truncate, only slightly projecting before eyes; mesonotum tricarinate; tegmina with the veins distinctly setigerous.

Long. excl. tegm. 3 mm. Exp. tegm. 8 mm.

Loc. Seychelles. Mahé: country above Port Glaud, about 500—1000 feet; forest above Cascade Estate; top of Mount Sebert, nearly 2000 feet.

148. *Volcanalia atrostriata*, sp. n. (Plate **50**, fig. 21 *a*).

Head, pronotum and mesonotum ochraceous; mesonotum with a central longitudinal fascia and the lateral areas, castaneous-brown; body beneath and legs very pale ochraceous; lateral margins and two central fasciæ to face, two central fasciæ to clypeus, black, apices of tibiæ and tarsi more or less pale brownish; tegmina pale castaneous-brown, the lateral and central area largely greyish-white, apical third more or less ochraceous, its inner and apical margins, and a costal spot beyond middle, pale castaneous-brown; vertex of head narrow between the eyes and roundly produced a little in front of them, its lateral margins distinctly, darkly, carinately reflexed; face about as long as clypeus, anteriorly truncate, a little anteriorly centrally produced, the lateral margins convexly ampliated; mesonotum finely tricarinate; tegmina with the veins obscurely setigerous.

Long. $4\frac{1}{2}$ mm.

Loc. Seychelles. Mahé: high damp forest at summit of Pilot, over 2000 feet; high forest behind Trois Frères, 1500—2000 feet.

I have seen a variety of this species in which the two central black fasciæ to the face are coalesced.

149. *Volcanalia atrovaria*, sp. n. (Plate **50**, fig. 18 *a*).

Head, pronotum and mesonotum pale ochraceous, lateral areas of mesonotum distinctly darker; body beneath and legs pale ochraceous; sublateral margins and two central narrow longitudinal fasciæ to face, a central spot at base and the apex of clypeus, and the anal abdominal appendage to female, black; tegmina greyish-white, more or less tinted with ochraceous, inner and outer basal marginal spots, two similarly placed spots beyond middle, a transverse line before apical third, a strongly curved longitudinal line to same and the apices of the apical veins, pale castaneous-brown; vertex narrow between eyes and roundly continued a little in front of same, its lateral margins distinctly carinately reflexed; face about as long as clypeus, anteriorly truncate, a little anteriorly centrally produced, the lateral margins convexly ampliated; mesonotum finely tricarinate; tegmina with the veins obscurely setigerous.

Long. 4 mm.

Loc. Seychelles. Silhouette: near Mont Pot-à-eau, about 1500 feet; high forest above Mare aux Cochons. Mahé: high forest of Morne Blanc; Mare aux Cochons district, 1000—2000 feet; Cascade Estate, forest, 1000—2000 feet.

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150. *Volcanalia designata*, sp. n.

Body and legs ochraceous; eyes black; face and clypeus ochraceous, the latter with a spot at base and the apex, black; tegmina hyaline much suffused with ochraceous, a slightly curved and broken transverse fascia at about two-thirds from base, from which, near middle, a longitudinal fascia extends to apex, and the apices of the apical veins, black; vertex narrow between eyes and a little roundly continued beyond them, the lateral margins distinctly ridged; face distinctly produced beyond eyes, its apex subtruncate, distinctly ampliated and rounded before clypeus, which is about as long as face; mesonotum tricarinate.

Fig. 1. *Volcanalia designata* Dist.

Long. 4½ mm.

Loc. Seychelles. Silhouette: high country near Mont Pot-à-eau.

151. *Volcanalia cardui*, sp. n. (Plate **50**, fig. 20 *a*).

Vertex of head sanguineous; pro- and mesonota pale ochraceous, the latter with the lateral areas and a central fascia pale castaneous-brown, the central fascia medially traversed by a sanguineous line; body beneath and legs pale ochraceous; face with an arcuated transverse fascia, extending to anterior margin, and clypeus with a narrow basal fascia, sanguineous; abdomen with lateral marginal black spots; tegmina with the basal two-thirds greyish, suffused with ochraceous and bluish-grey markings, apical third pale ochraceous, anteriorly margined with a curved fuscous transverse fascia, and inwardly and posteriorly margined with fuscous spots, a large white spot on its disk and a smaller white and fuscous spot on costal margin at about one-fourth from apex; vertex narrow between eyes and distinctly projecting beyond them, its lateral margins carinately reflexed; face a little longer than clypeus, with the anterior margin subtruncate, centrally moderately excavate, its lateral margins moderately oblique, moderately produced in front of eyes; mesonotum finely tricarinate; tegmina with the veins obscurely setigerous.

Long. 5 mm.

Loc. Seychelles. Mahé: all from stunted forest vegetation at the top of Mount Sebert, nearly 2000 feet, i. 1909.

152. *Volcanalia picturata*, sp. n. (Plate **50**, fig. 19 *a*).

Vertex of head, pro- and mesonota more or less fuscous-brown, with the margins and carinations paler; abdomen above black, the basal area and segmental margins testaceous; head beneath, sternum and legs pale ochraceous, abdomen beneath black, the segmental margins ochraceous, face with an arcuated anterior fascia, and clypeus with a very broad fascia, sanguineous; tegmina very pale dull ochraceous, the veins, three more or less oblique fasciæ and some apical spots, dull dark castaneous; wings pale fuliginous, with darker longitudinal shadings; vertex very narrow between eyes, its

margins strongly carinately reflexed, slightly passing anterior margins of eyes; face slightly longer than clypeus, with the lateral margins moderately oblique, its anterior margin notched and a little passing eyes; mesonotum finely tricarinate; tegmina with the veins distinctly setigerous.

Long. excl. tegm. $3\frac{1}{2}$ mm. Exp. tegm. 10 mm.

Loc. Seychelles. Silhouette: high forest near Mont Pot-à-eau; Mare aux Cochons, and forest above. Mahé: near Morne Blanc, about 1000 feet; high damp forest between Trois Frères and Morne Seychellois, about 1500—2000 feet; Cascade Estate, 800—1000 feet; Mare aux Cochons district, 1000—2000 feet.

153. *Volcanalia varicolor*, sp. n. (Plate **50**, fig. 16 *a*).

Head, pronotum and mesonotum pale dull ochraceous, posterior margin of pronotum, and apex and carinations to mesonotum stramineous; face pale stramineous, an arcuated transverse fascia between eyes and a very large basal spot to clypeus, sanguineous; sternum testaceous, legs ochraceous, anterior and intermediate legs with annulations to tibiæ and the tarsi wholly black; abdomen above black, the base testaceous; tegmina dull ochraceous, the veins darker, a pale stigmatal spot on each side of which the costal margin is dark fuscous, and a smaller pale spot opposite the costal one, on inner margin; wings pale fuliginous; vertex narrow, the lateral margins carinately reflexed, distinctly extended beyond eyes; face distinctly longer than clypeus, with the lateral margins oblique, the anterior margin distinctly angulate and moderately extending in front of eyes; mesonotum finely tricarinate; tegmina with the veins distinctly setigerous.

Long. 5 mm.

Loc. Seychelles. Silhouette: high forest above Mare aux Cochons. Mahé: country above Port Glaud, about 500—1000 feet; high forest behind Trois Frères; Mare aux Cochons district, 1000—2000 feet; Cascade Estate, about 1000 feet; forest near Mount Harrison, 1700 feet; high damp forest at summit of Pilot, over 2000 feet.

154. *Volcanalia fumosa*, sp. n. (Plate **50**, fig. 17 *a*).

Head, pronotum and mesonotum testaceous, the carinations paler; face, sternum and legs pale ochraceous, anterior area of face and basal margin of clypeus sanguineous; abdomen beneath piceous or black, the segmental margins ochraceous; tegmina with the basal two-thirds piceous or blackish (reflecting the dark abdomen beneath), the veins prominent, the costal margin, gradually widening posteriorly, and the whole of the apical area more or less pale brownish-ochraceous with the veins darker, a series of prominent spots to apical margin, preceded by two larger spots on costal margin, pale dull castaneous; vertex narrow between eyes, and distinctly slightly projecting beyond them, its lateral margins carinately reflexed, mesonotum distinctly tricarinate; face about as long as clypeus, with the lateral margins slightly convex, anteriorly distinctly projecting before eyes; tegmina with the veins distinctly setigerous.

Long. 4 mm.

Loc. Seychelles. Silhouette: near Mont Pot-à-eau, about 1500 feet; Mare aux Cochons, and forest above. Mahé: from high forest of Morne Blanc and Pilot, up to 2000 feet; country above Port Glaud, about 500—1000 feet; high damp forest between Trois Frères and Morne Seychellois, about 1500—2000 feet; forest above Cascade Estate; Mare aux Cochons district, 1000—2000 feet.

155. *Volcanalia modesta*, sp. n. (Plate **50**, fig. 15 *a*).

Vertex of head sanguineous; pro- and mesonota ochraceous; body beneath and legs pale ochraceous; face ochraceous, the apex sanguineous; tegmina very pale ochraceous, towards base reflecting the dark abdomen beneath, the margins of the apical area spotted with fuscous; vertex very narrow between eyes and projecting a little beyond them; mesonotum distinctly tricarinate; face a little longer than clypeus, with the lateral margins moderately oblique, its apex distinctly continued before eyes and moderately emarginate; tegmina with the veins distinctly setigerous.

Long. 4 mm.

Loc. Seychelles. Silhouette: high country near Mont Pot-à-eau. Mahé: from country above Port Glaud, about 500—1000 feet; high damp forest at summit of Morne Pilot, over 2000 feet; high damp forest between Trois Frères and Morne Seychellois, about 1500—2000 feet; Mare aux Cochons district, 1000—2000 feet; Cascade Estate, forest, 1000—2000 feet.

156. *Volcanalia uniformis*, sp. n.

Body and legs ochraceous; tegmina subhyaline with the veins stramineous, but when unexpanded reflecting the ochraceous body beneath; face ochraceous, more or less tinted with sanguineous, a waved oblique narrow sanguineous fascia commencing near anterior margin and continued on lateral areas of sternum; vertex narrow between eyes and distinctly projecting beyond them, its lateral margins distinctly ridged; face a little longer than clypeus, broadened and moderately convex towards clypeus, centrally and laterally carinate; pronotum strongly tricarinate; venation of the tegmina somewhat coarse.

Long. 5 mm.

Loc. Seychelles. Silhouette: from high country. Mare aux Cochons, and forest near by. Mahé: country above Port Glaud, about 500—1000 feet, forest above Cascade Estate and forest near Mount Harrison, 1700 feet.

Allied to the previous species *V. modesta*.

157. *Volcanalia capitata*, sp. n. (Plate **51**, fig. 2 *a*).

Vertex of head black; pronotum and mesonotum pale fuscous-brown; face pale fuscous or blackish, the apex sanguineous; body beneath and legs dull ochraceous; tegmina ochraceous, the apical area paler, base of costal margin, an angulated transverse fascia before apical area which has two spots on its outer margin and a series of smaller spots on its inner margin, fuscous-brown; vertex very narrow between eyes and very distinctly projecting beyond them; mesonotum distinctly tricarinate; face a

little longer than clypeus with its lateral margins moderately sinuately oblique, its apex truncate, and continued some distance before eyes, both face and clypeus strongly centrally carinate.

Long. incl. tegm. 4 mm.

Loc. Seychelles. Silhouette: from high forest above Mare aux Cochons.

Genus Brixia.

Brixia Stål, Öfv. Vet.-Ak. Förh., 1856, p. 162.

158. *Brixia mahensis*, sp. n. (Plate **49**, fig. 14 *a*).

Body and legs ochraceous, lateral areas of pronotum very pale ochraceous; interior area of face, behind eyes, a little darker; tegmina semihyaline, the veins darkly setigerous, two oblique transverse fuscous fasciæ (one basal directed outwardly, the other near middle directed inwardly), two blackish spots between these fasciæ, an arcuate blackish line before apical area, a transverse fascia in apical area and part of the inner apical margin fuscous, the latter with small marginal whitish spots, an ochraceous stigmatal costal spot; wings pale fuliginous, the venation darker; vertex of head narrow between the eyes, the lateral margins carinately reflexed; face centrally excavate, the lateral margins moderately convexly curved and very strongly carinately reflexed, a distinct pale ocellus at its base; mesonotum tricarinate.

Long. excl. tegm. 4 mm. Exp. tegm. 14 mm.

Loc. Seychelles. Mahé: from grass in cultivated country, about 1000 feet.
A single specimen.

159. *Brixia stellata*, sp. n. (Plate **49**, fig. 17 *a*).

Body and legs ochraceous; vertex of head carinations to pro- and mesonota and legs, very pale ochraceous; face with the interior area more or less castaneous; tegmina subhyaline, with an oblique fasciate-line near base, two subcostal spots before middle, a curved line before apical area, preceded by two oblique costal lines and some other discal suffusions, and an inner apical marginal fascia, fuscous, a distinct black spot near inner side of apical margin; wings very pale fuliginous, the veins darker; vertex of head distinctly extending beyond eyes, the lateral margins strongly carinately reflexed; face widened towards clypeus, the lateral margins strongly carinately reflexed, a distinct pale ocellus at its base; mesonotum tricarinate.

Long. excl. tegm. 4 mm. Exp. tegm. 13 mm.

Var. a. Darker in hue, the ground colour of the tegmina being subopaque and the markings more dark castaneous.

Var. b. Paler in hue than in type; all the markings more ill-defined, some absent.

Loc. Seychelles. Silhouette: from Mare aux Cochons, about 1000 feet. Mahé: high forest of Morne Blanc; country above Port Glaud, about 500—1000 feet; high

damp forest at summit of Pilot, over 2000 feet; high damp forest between Trois Frères and Morne Seychellois, about 1500—2000 feet; Cascade Estate; top of Mount Sebert, nearly 2000 feet; Mare aux Cochons district, 1000—2000 feet. Praslin: from Côtes d'Or Estate.

This species is found in great numbers in undergrowth in the damp mountain-forests, often in the endemic bush, *Senecio seychellensis* (Hugh Scott)*.

Curiatius, gen. nov.

Vertex of head moderately projecting in front of eyes, the apex centrally emarginate, the lateral apical angles moderately prominent, and deflected, centrally ridged, broadened at base between the eyes; face distinctly projecting before eyes, widened beneath eyes, the margins moderately convex and carinately reflexed, two small ocelli at base; clypeus elongate, almost as long as face, centrally carinate; antennæ with the first and second joints globosely thickened; pronotum very much shorter than head, posteriorly deeply emarginate, centrally ridged, mesonotum about as long as head and pronotum together, tricarinate; posterior tibiæ unarmed; tegmina more than twice as long as broad, two series of transverse veins on apical half, the inner series less continuous, veins mostly setigerous, especially on claval area; wings with a few upper discal transverse veins.

Allied to *Brixia* but differing by the long clypeus, two ocelli at base of face, &c.

160. *Curiatius insignis*, sp. n. (Plate **49**, fig. 12 *a*).

Body above brownish ochraceous, abdomen more or less suffused with white pile; body beneath and legs pale ochraceous, lateral areas of sternum more or less greyish; face castaneous, the lateral margins greyish; central carination to clypeus greyish; tegmina pale castaneous-brown, basal area of costal margin, a large costal stigmatal spot, and large apical marginal spots, pale dull ochraceous, on apical area the nerval interspaces are more or less greyish, to a little beyond middle the veins are darkly setigerous and on claval area this character is particularly marked, including the inner margin; wings very pale fuliginous; other structural characters as in generic diagnosis.

Long. excl. tegm. 4 mm. Exp. tegm. 14 mm.

Loc. Seychelles. Mahé: Cascade Estate, 800—1000 feet.

A single example.

* The association of *Brixia stellata*, and of two species of *Nisia* (*N. sulphurata* and *fuscofasciata*), with low-growing plants, and particularly with the endemic bush-groundsel, *Senecio seychellensis*, was remarked on many occasions in the damp mountain-forests. These small Homoptera appeared often to frequent this plant in great numbers. Compare the case of a new genus and species of Lamellicorn beetle, *Nesohoplia senecionis*, which was exclusively found on the *Senecio*.—H. Scott.

Subfamily **Tropiduchinæ**.

Daradaxoides, gen. nov.

Head long, strongly produced, longer than pronotum, almost as long as mesonotum, the lateral margins somewhat obliquely straight from base to anterior margins of eyes and then obliquely narrowed to apex which is truncately rounded, the margins strongly ridged, and a central longitudinal ridge; eyes longer than broad; face long, centrally and laterally ridged, slightly concave at region of eyes, obliquely narrowed before apex; clypeus short, broad, centrally ridged; pronotum short, discally, conically produced between the eyes where it is centrally and laterally ridged, depressed at lateral areas, the lateral angles prominent behind eyes, posterior margin angularly concave; mesonotum strongly, discally tricarinate; posterior tibiæ with three spines a little beyond middle; tegmina a little more than twice as broad as long, costal membrane slightly broader than radial area, the first and apical margin closely obliquely veined, the second more sparingly veined, the discal veins longitudinal for about two-thirds from base, the subapical area more or less reticulate; wings shorter than tegmina, the posterior margin moderately waved, longitudinally veined except on apical area where the veins are more or less furcate.

Allied to *Daradax* Walk., a genus represented in Malacca and Borneo.

161. *Daradaxoides mahensis*, sp. n. (Plate **49**, fig. 5 *a*).

Body and legs pale virescent; eyes a little darker and more testaceous in hue; tegmina semiopaque, the veins pale virescent; wings hyaline. Structural characters as in generic diagnosis.

Long. excl. tegm. 5½ to 7 mm. Exp. tegm. 12 to 15 mm.

Loc. Seychelles. Mahé: 5 specimens; from near Morne Blanc; Cascade Estate; top of Mount Sebert, nearly 2000 feet; Mare aux Cochons district, 1000—2000 feet.

Subfamily **Achilinæ**.

Parakosalya, gen. nov.

Head including eyes a little narrower than pronotum, vertex longer than broad, distinctly projecting before eyes, its margins carinate and with a distinct central ridge; face longer than broad, towards clypeus moderately ampliate, laterally and centrally ridged; clypeus about half as long as face with a strong central ridge and its lateral margins carinate; pronotum short, centrally tricarinate, posterior margin strongly angularly emarginate; mesonotum, slightly longer than vertex and pronotum, tricarinate; legs long and slender, posterior tibiæ with one spine before middle, posterior tarsi with the basal joint very long; tegmina apically moderately widened, distinctly ampliate behind the clavus, two series of more or less complete transverse veins on apical half, wings considerably wider than tegmina.

Allied to the Oriental genus *Kosalya* Dist., from which it differs by the longer and more projecting vertex of head, the different shape of the face, the shorter mesonotum, and only one spine to the posterior tibiæ.

162. *Parakosalya insularis*, sp. n.

Head, pronotum, mesonotum, base of abdomen, body beneath and legs ochraceous; abdomen above, excluding base, sanguineous; tegmina creamy-ochraceous, the costal membrane much paler; wings pale fuliginous; vertex with two small black impressions between the eyes; abdomen above with a distinct central ridge; other structural characters as in generic diagnosis.

Long. excl. tegm. 3 mm. Exp. tegm. 8 mm.

Loc. Seychelles. Silhouette: forest above Mare aux Cochons.

Fig. 2. *Parakosalya insularis* Dist.

Subfamily **Derbinæ**.

Of the six genera here enumerated four appear to be unknown and are here described. There can be no doubt that, as has been remarked by other workers, the Derbinæ are closely related to the Cixiinæ, and in some instances it is difficult to draw the line between the two groups or subfamilies. Those described here are all small species for which we are indebted to the assiduous collecting of Mr Hugh Scott and will in all probability be again discovered, either generically or specifically in Madagascar and the adjacent islands.

Iguvium, gen. nov.

Vertex of head narrow, prominently projecting before the eyes, widened towards base, with eyes very much narrower than pronotum; antennæ with the second joint of moderate length but strongly incrassate; face narrow, the margins ridged, strongly projecting before eyes; clypeus short and broad, shorter than face; pronotum short and broad, the anterior margin sinuate, the lateral angles subacute, posterior margin moderately concavely sinuate; mesonotum about as long as pronotum and head together, moderately narrowed posteriorly; tegmina more than twice as long as broad, narrow at base, inner margin gradually arched from base to about middle where the tegmen is roundly broadened, costal membrane with three transverse veins, remaining venation better seen in the enlarged figure here given; wings short and narrow.

Two carded specimens afford small opportunity for detailed structural characteristics.

The genus is allied to *Pamendanga* Dist.

163. *Iguvium albomaculatum* sp. n. (Plate **51**, fig. 5 *a*).

Body and legs ochraceous with darker mottlings; eyes black; pronotum with two central and two sublateral fuscous spots; mesonotum with similar anterior spots and two larger dark castaneous posterior spots; tegmina subhyaline, the venation

greyish-white, crossed by five fuscous fasciæ of which the three basal are narrowest, and all containing more or less prominent greyish-white spots, on costal margin near apex are some distinct testaceous markings; wings subhyaline, other structural characters as in generic diagnosis.

Long. incl. tegm. 5 mm.

Loc. Seychelles. Silhouette: Mare aux Cochons plateau. Mahé: Cascade Estate, about 800 feet.

The description of this very distinct species has been derived from two carded specimens, both of which have been used for that purpose.

Genus Fescennia.

Fescennia Stål, Hem. Afr. iv. p. 198 (1866).

This genus was founded by Stål for the reception of a species described by Coquerel, as *Phenice bivittata* from Mayotta Isld. and Madagascar. Stål however renamed it as *F. laticeps* without giving any reason. Coquerel's description is much more obscure than that of Stål's, but it was published in 1859, and should take precedence. I have not seen the type of the genus, but the two species here described seem clearly to belong to *Fescennia*.

164. *Fescennia bimaculata*, sp. n. (Plate **51**, fig. 11 *a*).

Body and legs pale ochraceous, more or less greyishly pubescent; eyes testaceous; tegmina palely flavescent, a black spot near apex and a similar spot near middle of inner margin; wings subhyaline, with some opalescent reflexions; head including eyes about as wide as pronotum, vertex broad, triangular, the apex emarginate distinctly projecting beyond eyes; clypeus long, tricarinate, a little shorter than face; second joint of antennæ very short; mesonotum tricarinate, the sublateral carinations obscure; tegmina elongate, about three times longer than broad, beyond medium a little broadened, about three times longer than clavus; wings about a third part shorter than tegmina.

Long. excl. tegm. 4 mm. Exp. tegm. 13 mm.

Loc. Mahé: Mare aux Cochons district, 1000—2000 feet.

A single example only contained in the collection.

165. *Fescennia aurea*, sp. n. (Plate **51**, fig. 10 *a*).

Body and legs pale ochraceous, more or less greyishly pubescent; tegmina flavescent with a black spot near middle of inner margin and the apical margin narrowly fascescent; wings subhyaline with opalescent reflexions. Allied to the preceding species *F. bimaculata*, but the face a little broadened posteriorly, clypeus a little narrower; some minor differences in venation of tegmina better shown than described in the figures of the two species.

Long. excl. tegm. 4 mm. Exp. tegm. 14 mm.

Loc. Seychelles. Silhouette; Mare aux Cochons. Mahé: Cascade Estate, about 800—1500 feet. A single example from each locality.

AQUÆLICIUM, gen. nov.

Vertex of head narrow, projecting beyond the eyes, broadened towards base which is moderately angularly excavated; eyes large, oblong, reaching base of head; antennæ long, first and second joints strongly incrassated, basal joint short, second joint long, about as long as mesonotum, subdepressed; face long, very narrow and slender projecting beyond the eyes; rostrum with the second joint nearly twice as long as the first, the apical joint minute; pronotum short, anteriorly subconically produced, posteriorly moderately concave, the lateral angles a little angularly produced; mesonotum a little longer than head and pronotum together, obscurely tricarinate, the central carination distinct, the sublateral carinations oblique, short, and more or less obscure; posterior tibiæ not spined, posterior tarsi with the basal joint about as long as the remaining joints together; tegmina about two and a half, or three times as long as broad; costal membrane broad, obliquely transversely veined beyond middle, and again before apex, principal veins longitudinal, a submarginal series of transverse veins, and beneath the second longitudinal interspace, and at the apices of the third and fourth shorter interspaces are a series of short oblique veins, apical margin rounded, inner margin concavely sinuate before apex; wings about as broad and little shorter than tegmina, two transverse veins on upper disk.

166. *Aquælicium typicum*, sp. n. (Plate **49**, fig. 11 *a*).

Body above fuscous-brown; vertex of head and a central longitudinal fascia to pro- and mesonota, dull greyish; body beneath and legs ochraceous, apical area of abdomen beneath more or less castaneous; tegmina pale fuscous-brown, apices of the upper apical veins sanguineous, a large spot crossing costal membrane beyond middle, a smaller spot near apex, apices of the lower apical veins and spots on inner margin, greyish-white; wings pale fuliginous, the veins darker; basal incrassated joints of antennæ dark fuscous; face prominently extending before eyes which are black; other structural characters as in generic diagnosis.

Long. excl. tegm. 2 mm. Exp. tegm. 7 mm.

Loc. Seychelles. Silhouette: Mare aux Cochons. Mahé: near Morne Blanc; country above Port Glaud, about 500—1000 feet; Cascade Estate, and forest above; top of Mount Sebert, nearly 2000 feet.

167. *Aquælicium elegantulum*, sp. n. (Plate **51**, fig. 9 *a*).

Body above dark fuscous-brown; vertex of head and a central fascia to pro- and mesonota, ochraceous; body beneath fuscous-brown; clypeus and legs ochraceous, the latter tinted with pale sanguineous; tegmina very dark fuscous-brown, the costal and apical margins sanguineous, a spot near apex of clavus, two transverse lines on inner margin and transverse lines on inner apical margin, pale ochraceous; vertex of head distinctly prominent; incrassated second joint of antennæ very dark fuscous and more slender than in the previous species *A. typicum*.

Long. $3\frac{1}{2}$ mm.

Loc. Seychelles. Silhouette: Mare aux Cochons. Mahé: high forest of Morne Blanc and Pilot; forest above Cascade Estate; Mare aux Cochons district. Félicité Island: from forest.

168. *Aquælicium brunnescens* (Plate **51**, fig. 7 *a*).

Body above fuscous-brown; vertex—excluding apex—ochraceous, an obscure pale longitudinal fascia to pro- and mesonota; body beneath fuscous, clypeus and legs ochraceous, tegmina pale fuscous, the veins darker; vertex of head distinctly prominent; incrassated second joint of antennæ very dark fuscous, in shape and substance much as in preceding species *A. elegantulum* from which it differs by its different coloration and pattern.

Long. $3\frac{1}{2}$ mm.

Loc. Seychelles. Silhouette: high country near Mont Pot-à-eau. Mahé: near Morne Blanc; Cascade Estate, about 800 feet and over.

EQUIRRIA, gen. nov.

Allied to the previous genus *Aquælicium*, especially by the strongly incrassated first and second joints of the antennæ, the second joint very long, but differing in the following characters—Vertex of head considerably broader, subtriangular, excavate, apex subtruncate; face broader, projecting similarly before eyes, but with the apex a little broadened, the lateral margins strongly elevately carinate; clypeus shorter, only about half the length of face; tegmina about two and a half times as long as broad, costal membrane broad, with two oblique transverse veins beyond middle, principal veins oblique not longitudinal with a sub-inner series of transverse veins, inner margin not distinctly concavely sinuate before apex; wings distinctly narrower than tegmina, two transverse veins on upper disk as in *Aquælicium*.

169. *Equirria phalæna*, sp. n. (Pl. **51**, fig. 6 *a*).

Body and legs pale dull ochraceous, more or less greyishly pubescent; antennæ pale castaneous; tegmina subhyaline, a subcostal fascia, an oblique fascia near base, a discal, elongate, oblique spot, a curved fascia near apical angle, and a subapical marginal line, either pale or dark fuscous; wings subhyaline, posterior halves of the veins on basal half, infuscated; vertex of head triangular moderately projecting beyond the anterior margins of the eyes; other structural characters as in generic diagnosis.

Long. excl. tegm. $3\frac{1}{2}$ mm. Exp. tegm. $15\frac{1}{2}$ mm.

Loc. Seychelles. Mahé: from near Morne Blanc, ca. 800—1000 feet.

FORDICIDIA, gen. nov.

Allied to the two preceding genera *Aquælicium* and *Equirria* by the strongly incrassated basal joints of the antennæ, the second joint very long; it is allied to *Aquælicium* by the longitudinal veins to the tegmina and the slender narrow face,

but it differs from that genus by the shorter and broader head and by the apex of the face being broader, less produced before eyes and emarginate; from *Equirria* it differs by the longitudinal direction of the principal veins to the tegmina, the narrow face and the long clypeus, nearly as long as the face, but is allied to that genus by the shorter and broader vertex of head; the tegmina are apically more narrowed than in either of the above genera, for the venation of which the three figures given for the three genera give a better guide than does a written description.

170. *Fordicidia robusta*, sp. n. (Plate **51**, fig. 15 *a*).

Body and legs flavescent; tegmina subhyaline, much suffused with pale fuscous, in typical specimens as the one figured—three basal spots crossing claval area, two longitudinal spots above them, followed by an irregular transverse series of spots and subapical shadings, in some specimens these markings are much obliterated and the spots diminished in number; wings subhyaline, the veins darker; vertex of head short, triangular, but with eyes considerably narrower than pronotum; mesonotum somewhat obscurely tricarinate; body short and robust; face narrow, a little widened towards clypeus, its lateral margins strongly ridged; second joint of antennæ long and incrassated, other structural characters as in the generic diagnosis.

Long. excl. tegm. 2 to $2\frac{1}{2}$ mm. Exp. tegm. 10 mm.

Loc. Seychelles. Silhouette: forest above Mare aux Cochons. Mahé: Cascade Estate, 800—1000 feet and over; high forest behind Trois Frères, 1500—2000 feet.

Genus Nisia.

Nisia Melich., Hom. Faun. Ceylon, p. 53 (1903); Dist., Faun. Brit. Ind. Rhynch. iii. p. 309 (1906).

The position of this genus is still *sub judice*; Melichar placed it in the Derbinæ and I followed him, though of course its aberrant structure among the Derbids cannot be overlooked. Muir (Bull. H. S. P. Ent. xii. p. 29, 1913) writes of *Nisia* and two other genera: "I exclude them from the family *Derbidæ*, but, inconsistently, have included them in this Bulletin because several of our greatest authorities on Homoptera have considered them as Derbids." Muir seems inclined to the view that *Nisia* belongs to the Cixiinæ. Matsumura (Ann. Mus. Nat. Hung. xii. p. 287, 1914) places the genus in the Achilinæ.

Under these qualifications I leave *Nisia* among the Derbids, a position which perhaps does not seem congenial and from which it will probably be ultimately transferred.

171. *Nisia atrovenosa.*

Meenoplus atrovenosus Leth., Ann. Mus. Genov. xxvi. p. 466 (1888).

Nisia atrovenosa Melich., Hom. Faun. Ceylon, p. 53 (1903); Dist., Faun. Brit. Ind. Rhynch. iii. p. 309, fig. 150 (1906); Muir, Rept. Exp. Stat. Haw. S. Plant. Assoc. Bull. 12, p. 81 (1913).

Loc. Seychelles. Mahé: Port Victoria, from Botanic Gardens; near Morne Blanc; marshes on coastal plain at Anse aux Pins and Anse Royale; Cascade, marshy cultivated country near sea-level. Félicité. Praslin. Silhouette: from the marsh at Mare aux Cochons. Found on water-plant which grows in marshes.

This species is also recorded from Trincomalee, Ceylon, Nias Islands, Borneo, Piroe and Formosa.

172. *Nisia sulphurata*, sp. n.

Body and legs pale ochraceous; tegmina sulphur-yellow; wings fuliginous, the veins darker; head including eyes narrower than pronotum, vertex and face continuous, their lateral margins strongly carinate and elevate, vertex of head longitudinally concave; face longer than broad; clypeus longitudinally centrally ridged; pronotum centrally longitudinally carinate; mesonotum obscurely tricarinate; tegmina more than twice as broad as long, costal margin distinctly arched on basal half, apical area with five longitudinal veins, the upper connected near base, as in *N. atrovenosa*.

Long. excl. tegm. $2\frac{1}{2}$ to 3 mm. Exp. tegm. 10 to 12 mm.

Loc. Seychelles. Silhouette: near Mont Pot-à-eau. Mahé: from near Morne Blanc; high damp forest at summit of Morne Pilot, over 2000 feet; high damp forest between Trois Frères and Morne Seychellois, about 1500—2000 feet; forest above Cascade Estate; top of Mount Sebert, nearly 2000 feet. Praslin: Côtes d'Or Estate, from Coco-de-Mer forest in the Vallée de Mai.

Found in great numbers in undergrowth (*Senecio seychellensis*, &c.) in the damp mountain-forests (Hugh Scott).

173. *Nisia maculosa*, sp. n. (Plate **51**, fig. 4 *a*).

Vertex of head and pronotum greyish-ochraceous; mesonotum castaneous with a large black spot at each lateral angle; face, sternum and legs pale ochraceous, the first centrally more or less fuscous; pro- and mesosterna transversely fuscous; abdomen beneath testaceous, more or less transversely fuscous; tegmina greyish-ochraceous, an oblong spot beyond middle of clavus, an elongate spot above clavus, and a large spot —apically widened on apical area, fuscous-brown; vertex and face with the lateral margins strongly ridged and elevated; clypeus strongly centrally ridged; pronotum centrally carinate, mesonotum moderately tricarinate; tegmina with the costal margin distinctly arched near middle.

Long. incl. tegm. 6 mm.

Loc. Seychelles. Mahé: high damp forest between Trois Frères and Morne Seychellois, about 1500—2000 feet.

174. *Nisia fuscofasciata*, sp. n. (Plate **51**, fig. 3 *a*).

Vertex of head, pronotum and mesonotum ochraceous, the latter with an oblique black fascia on each lateral area; body beneath and legs ochraceous, abdomen and sometimes the sternum with fuscous suffusions; tegmina pale ochraceous, an inner broad longitudinal fuscous fascia continued on apex; vertex of head and face with the lateral

margins strongly carinately elevated; clypeus ridged; tegmina moderately arched near middle of costal margin.

Long. incl. tegm. 5 mm.

Loc. Seychelles. Silhouette: high country near Mont Pot-à-eau; Mare aux Cochons, plateau and jungle near by, all from marshy plateau. Mahé: Cascade Estate.

Found in great numbers in undergrowth (*Senecio seychellensis*, &c.) in the damp mountain-forests (Hugh Scott)*.

175. *Nisia thoracica*, sp. n.

Vertex of head, face, pronotum, and legs pale stramineous; eyes black; mesonotum pale tawny-brown; body beneath ochraceous; tegmina creamy-white; anterior and intermediate tarsi more or less infuscate; vertex of head moderately concave, with the anterior lateral angles strongly pronounced; face strongly concave, the lateral margins strongly ridged and subparallel, much longer than broad; pronotum narrow, the posterior margin strongly angulate; mesonotum with the central carination strongly developed.

Long. incl. tegm. 5 mm.

Loc. Seychelles. Silhouette: forest above Mare aux Cochons.

A single example of this distinct species.

There is another species of this genus represented by a single mutilated specimen, not available for specific description. It is allied to *N. maculosa* Dist.

Subfamily **Lophopinæ.**

Genus Ivinga.

Ivinga Dist., Trans. Linn. Soc. Lond. Zool. xiii. p. 42 (1909).

176. *Ivinga typica* Dist., Trans. Linn. Soc. Lond. Zool. xiii. p. 42, Plate 4, fig. 5 *a* (1909).

Loc. Seychelles: found not only in the endemic mountain-forests (where it was commonly beaten from the endemic "Bois Rouge" tree, *Wormia ferruginea*, and from other plants), but also among non-endemic vegetation near sea-level. Silhouette: Mahé. Anonyme Island. Dennis Island. Praslin. Félicité. Marie Anne.

Aldabra: 1907 (Thomasset), 1908 (Fryer).

In describing this species I gave the colour as dark ochraceous as is also the invariable appearance of a very large number of specimens examined since. Mr Scott has however added the note—"all these are light green during life." This is a very common discoloration after death in many Cicadidæ and other Homoptera.

Subfamily **Issinæ.**

Only two species of one genus were brought home by this expedition. The genus (*Lollius*) has previously only been recorded from the Malayan and Papuan regions, while an allied genus *Tylana*, represented on the Islands of Mauritius and Bourbon, was unrepresented in this Seychelles collection.

* See footnote, p. 285.

Genus Lollius.

Lollius Stål, Hem. Afr. iv. p. 209 (1866); Öfv. Vet.-Ak. Förh. xxvii. p. 762 (1870).

Type. *L. furcifer* Stål, from the Philippine Islands.

In his "Monographie der Issiden," Melichar figures his *L. gratiosus* from N. Guinea, which is scarcely typical of the genus. The two species here described agree with the type *L. furcifer* Stål.

177. *Lollius atromaculatus*, sp. n. (Plate **50**, figs. 7 *a*, *b*).

Brownish-ochraceous, speckled and marked with black, tegmina with a large shining black spot, bounded and divided by veins a little behind middle, the veius more or less testaceous; anterior and intermediate legs with black annulations, posterior femora black, the tibiæ black at base and apex; abdomen beneath with black markings. principally a black longitudinal fascia near base; vertex of head concave, the lateral margins strongly ridged, the apical margin with three short spines, one central and one at each apical angle; face with the anterior lateral spines more prominent, tricarinate, the lateral carinations curved inwardly, anteriorly and posteriorly, the whole surface speckled with black; costal and apical margins to tegmina with more or less elongate black spots, the apical margins broadly, obliquely truncate.

Long. incl. tegm. $8\frac{1}{2}$ mm.

Loc. Seychelles. Mahé: high damp forest between Trois Frères and Morne Seychellois, about 1500—2000 feet; forest above Cascade Estate, 1000—2000 feet.

178. *Lollius virescens*, sp. n. (Plate **50**, figs. 8 *a*, *b*).

Head, pronotum, mesonotum, body beneath and legs more or less ochraceous, anterior and intermediate legs annulated with fuscous, posterior femora, and bases of the tibiæ fuscous; coxæ and base of abdomen greyish-white, basal area of abdomen beneath—excluding basal margin—black, with greyish-white marginal spots; tegmina pale greenish-ochraceous, a small black spot at base, the apical margin spotted with black; clypeus with two black lines or elongate spots. In structural characters this species is closely allied to *L. atromaculatus*.

Long. incl. tegm. $8\frac{1}{2}$ mm.

Loc. Seychelles. Mahé: from forest of rather stunted Capucin trees (*Northea*) on summit of "Montagne Anse Major," 2000 feet or over; slopes of Morne Seychellois, about 1500—2000 feet.

Subfamily **Ricaniinæ**.

This subfamily of the Fulgoridæ is well represented in the Seychelles but is without any representative of its dominant genera such as *Pochazia*, *Ricania* and *Ricanoptera*, which being both Ethiopian and Oriental in their distribution might have been expected to be found in this fauna. *Privesa* however occurs in these islands as well as in the Ethiopian, Oriental and Australasian regions. Several other distinct genera required recognition.

DEFERUNDATA, gen. nov.

Vertex of head broad and narrow, anterior and lateral margins ridged, centrally carinate, and with eyes about as broad as anterior margin of pronotum; face slightly broader than long, the anterior margin truncate, centrally and sublaterally carinate, the lateral margins narrowing near clypeus which is also centrally carinate; pronotum short, centrally longitudinally ridged, its anterior margin convex, its posterior margin concave; mesonotum about twice as long as vertex and pronotum together, tricarinate, the lateral carinations anteriorly inwardly forked; legs of moderate length, posterior tibiæ with two spines before apex; tegmina twice as long as broad, costal margin prominently convexly raised at base, slightly waved beyond middle, costal membrane narrower than radial area near base, somewhat closely transversely veined, apical margin obliquely convex, inner margin beyond base, straight, outer disk transversely reticulately veined, two transverse lines near apical margin defining numerous narrow cellular spaces; wings a little shorter and about as broad as tegmina, a few transverse veins on upper disk beyond middle; abdomen above centrally longitudinally sulcate.

179. *Deferundata aldabrana*, sp. n. (Plate **50**, fig. 1 *a*).

Head, pronotum and mesonotum brownish-ochraceous; vertex with two central longitudinal black fasciæ, mesonotum with anterior and lateral black spots; abdomen pale ochraceous, the segmental margins black or fuscous; face brownish-ochraceous, the lateral areas finely spotted with black; sternum and legs brownish-ochraceous; tegmina bronzy-ochraceous, the posterior claval margin distinctly darker; wings very pale fuliginous, the veins and apical marginal area a little darker; structural characters as in generic diagnosis.

Long. excl. tegm. 5 mm. Exp. tegm. 16½ mm.

Loc. Aldabra: Île Michel; Takamaka (Fryer).

ARMILUSTRIUM, gen. nov.

Vertex of head transverse, broad, excluding eyes narrower than pronotum and about twice as broad as long, margins ridged, anterior margin a little rounded, anterior lateral angles prominent, eyes backwardly directed along the lateral margins of the pronotum; face considerably broader than long, anterior margin truncate, centrally and sublaterally carinate, the sublateral carinations convexly meeting near anterior margin; clypeus with a central carination, the lateral margins obscurely ridged; pronotum short, slightly longer than vertex, centrally longitudinally ridged; mesonotum large and long, considerably longer than head and pronotum together, tricarinate, the lateral carinations anteriorly, inwardly bifurcating; posterior tibiæ with two spines beyond middle; tegmina about twice as long as broad, costal membrane narrow, much narrower than radial area, basal cell longer than broad, longitudinal veins bifurcating beyond middle, a subapical series of transverse veins, preceded by a straight and well-defined impression; wings shorter and broader than tegmina, two outer discal transverse veins, some veins bifurcating on outer margin.

180. *Armilustrium gardineri*, sp. n. (Plate **50**, fig. 3 *a*).

Head, pronotum and mesonotum bronzy-brown; abdomen with the base pale sanguineous, apical half black, sometimes with the segmental margins testaceous; body beneath and legs brownish-ochraceous, apical area of abdomen beneath, blackish; tegmina shining pale bronzy-brown, irrorated with paler markings, of which two central ones are transverse and angularly directed outwards, a prominent black spot on lower half of apical margin; wings fuliginous, darker on apical area; vertex, pronotum and mesonotum, thickly, finely granulose; face with an anterior transverse ridge; other structural characters as in generic diagnosis.

Long. excl. tegm. 4 to 5 mm. Exp. tegm. 10 to 14 mm.

Loc. Seychelles. Silhouette: from highest forest, over 2000 feet. Mahé: high forest of Morne Blanc and Pilot. One imperfect specimen from each locality.

181. *Armilustrium scotti*, sp. n. (Plate **50**, fig. 4 *a*).

Head, pronotum and mesonotum bronzy-brown; abdomen sanguineous, with broad, shining-black, transverse, segmental fasciæ, extreme lateral margins sanguineous; body beneath and legs brownish-ochraceous, abdomen as above; tegmina greyish-white irregularly speckled with brownish-ochraceous venation shining yellow, a prominent black spot on lower half of apical margin, wings mutilated in typical specimen.

Differs from the preceding species *A. gardineri* by its larger size, different coloration of the abdomen, and by the practical absence of the anterior transverse ridge to the face.

Long. excl. tegm. 6 mm. Exp. tegm. 13 mm.

Loc. Seychelles. Mahé: Cascade Estate, about 800—1500 feet.

One imperfect specimen.

Carmentalia, gen. nov.

Vertex of head broad, about twice as broad as long, excluding eyes a little narrower than pronotum, centrally and marginally carinate, anterior margin a little angularly convex; face about as long as broad, anterior margin truncate, lateral margins obliquely widening to posterior margins of eyes and then obliquely narrowing to clypeus, centrally longitudinally carinate and with two curved ridges on anterior area; clypeus centrally ridged; pronotum about as long as head, centrally ridged, anterior margin broadly convex, posterior margin moderately concave; mesonotum large and long, considerably longer than head and pronotum together, tricarinate, the lateral carinations inwardly furcate near anterior margin, posterior tibiæ with a distinct spine beyond middle; tegmina twice as broad as long, costal membrane very narrow, costal margin very finely spinulose, reticulately veined beyond middle, and with a subapical series of transverse veins; wings shorter and broader than tegmina, two transverse veins on anterior disk and some of the veins furcate on apical and posterior margins.

182. *Carmentalia biformis*, sp. n. (Plate **50**, fig. 5 *a*).

Vertex, pronotum and mesonotum ochraceous; abdomen above more or less sanguineous; body beneath and legs very pale ochraceous; tegmina subhyaline, claval

area and apical area of posterior margin more or less fuscous-brown, a distinct black spot on lower half of apical margin; wings hyaline, the venation pale ochraceous; eyes black, lateral marginal areas of mesonotum, castaneous; structural characters as in generic diagnosis.

Var. a. Tegmina without the fuscous-brown suffusions, these being replaced by pale yellowish.

Long. excl. tegm. 5 to 6 mm. Exp. tegm. 15 mm.

Loc. Seychelles. Silhouette: Mare aux Cochons, and high forest above. Mahé: near Morne Blanc, about 1000 feet; top of Mount Sebert, nearly 2000 feet; Cascade Estate, about 1000 feet; forest near Mount Harrison 1700 feet.

Neoprivesa, gen. nov.

Allied to *Privesa* but differing by the costal membrane of the tegmina being very narrow for about one-fourth from base and then moderately ampliated towards apex; in the type specimen here figured there is a transverse vein to the lower ulnar area, but this is not a constant character; the face is shorter and broader, and the vertex distinctly conically rounded. The structure of the costal membrane to the tegmina, and the conically rounded anterior margin of the vertex compel generic separation.

183. *Neoprivesa fuscovaria*, sp. n. (Plate **49**, figs. 8, 8 *a*).

Body above brownish-ochraceous, more or less spotted or suffused with black; margins of vertex before eyes, and carinations to pro- and mesonota, pale ochraceous; body beneath and legs pale ochraceous, face finely sprinkled with fuscous; tegmina subhyaline with fuscous-brown markings and suffusions, the most prominent of these are oblique, irregular fasciæ on apical area; the transverse veins to costal membrane are prominently fuscous; wings hyaline, the veins, apical margin and a longitudinal streak—widened posteriorly—before abdominal area, dark fuliginous; vertex conically rounded in front; pronotum with the lateral areas ochraceous.

Long. excl. tegm. 7 mm. Exp. tegm. 19 mm.

Loc. Seychelles. Mahé: country above Port Glaud, about 500 to 1000 feet; Baie Lazare; Anonyme Island. Silhouette: Mare aux Cochons.

Aldabra; 1907 (Thomasset), 1908 (Fryer).

Genus Privesa.

Privesa Stål, Rio Jan. Hem. ii. p. 70 (1858); Melich., Ann. Hofmus. Wien, xiii. p. 282 (1898); Dist., Faun. Brit. Ind. Rhynch. iii. p. 386 (1906).

Dechitus Walk., Journ. Ent. i. p. 311 (1862).

184. *Privesa fryeri*, sp. n. (Plate **49**, fig. 7 *a*).

Body and legs ochraceous; a spot on each side of vertex and a discal central spot to pronotum divided by a median pale carinate line, fuscous; mesonotum more

or less suffused with fuscous, the carinations pale ochraceous; apical abdominal appendages fuscous; face with four dark spots near anterior margin and a sublateral series of small fuscous spots on each side; clypeus with oblique dark striæ on each side; tegmina more or less fuscous much darker in some places than in others, two large pale spots in costal membrane, the first usually ochraceous, the second hyaline with the veins ochraceous, and more narrowly continued on radial area, two large oblique hyaline spots on disk, a similar but smaller spot at apex, the apical margin also suffused with hyaline; wings hyaline, the veins, margin and a longitudinal suffusion near abdominal area, fuliginous; anterior angles of vertex slightly prominent; face with the anterior margin truncate, centrally longitudinally carinate, the lateral margins subparallel; mesonotum with three longitudinal carinations, the lateral ones anteriorly inwardly forked; posterior tibiæ with two strong spines.

Long. excl. tegm. 6 mm. Exp. tegm. 16 to 17 mm.

Loc. Aldabra (Fryer). Assumption (Fryer).

This species is allied to *P. punctifrons* Sign., by the sublateral punctate markings to the face, a species recorded from Madagascar and the Comoro Islands. It cannot however be that species as Signoret describes it "élytres entièrement hyalines, sans macule au bord supérieur."

185. *Privesa melanaria*, sp. n. (Plate **49**, fig. 6 *a*).

Vertex and pronotum ochraceous with fuscous spots, the two most prominent being on vertex; mesonotum dark ochraceous or castaneous with black macular suffusions; abdomen above fuscous, the segmental margins pale ochraceous; body beneath and legs ochraceous, face with two transverse black fasciæ and a sublateral series of small transverse spots; clypeus with dark oblique striæ on each side; tegmina brownish-ochraceous, the costal membrane and apical margin hyaline with scattered brownish-ochraceous spots, the disk more or less suffused with darker markings, and in well-preserved specimens greyishly tomentose, a grey curved line at inner margin of apical area; wings dark fuliginous; vertex with the anterior angles distinctly acutely prominent, face thus appearing slightly concave at anterior margin, its lateral margins obliquely rounded; pronotum strongly centrally carinate; mesonotum longitudinally tricarinate, the lateral carinations inwardly anteriorly forked; posterior tibiæ with two strong spines.

Long. excl. tegm. 6 to 6½ mm. Exp. tegm. 17 mm.

Loc. Seychelles. Mahé: Long Island, vii. 1908. Silhouette: near Mont Pot-à-eau.

The structure and markings of the face give this species a very distinct appearance.

Privesana, gen. nov.

Allied to *Privesa* Stål, from which it principally differs in the width of the costal membrane, which in *Privesa* is considerably broader than the radial area; in *Privesana* it is scarcely more than half the breadth of the radial area.

186. *Privesana infusca.*

Privesa infusca Dist., Trans. Linn. Soc., Ser. 2, Zool. xiii. p. 42, Pl. **4**, fig. 5 *a* (1909).

Loc. Seychelles. Mahé, 1905 and 1908—9; Cascade Estate, over 1000 feet; near Morne Blanc. Silhouette: Mare aux Cochons, 1908. Praslin, 1905. In Scott's experience this species was exclusively found among fallen dead leaves of the endemic screw-pine tree, *Pandanus hornei*, in the mountain-forests.

Genus Osaka.

Osaka Dist., Trans. Linn. Soc. Lond. Zool. xiii. p. 43 (1909).

187. *Osaka hyalina.*

Osaka hyalina Dist., Trans. Linn. Soc., Ser. 2, Zool. xiii. p. 44, Pl. **4**, figs. 15, 15 *a* (1909).

Loc. Seychelles. Silhouette: near Mont Pot-à-eau, and from Mare aux Cochons, about 1000 feet. Mahé; near Morne Blanc, Cascade Estate, 800—1000 feet. Marie Anne Island.

Aldabra: Takamaka; Île Michel (Fryer).

188. *Osaka relata.*

Osaka relata Dist., Trans. Linn. Soc., Ser. 2, Zool. xiii. p. 44 (1909).

Loc. Seychelles. Mahé; from near Morne Blanc, 1908. Cousin Island, 1905. Praslin, 1908.

Aldabra: Takamaka, 1908 (Fryer).

Subfamily Flatinæ.

None of the larger and more handsome species of this subfamily have been received from the Seychelles, such as the large and conspicuous *Phromnia rubra* Sign. found somewhat common in Madagascar. In fact I can only now enumerate three species, and we may therefore conclude that the Flatinæ are very poorly represented.

Genus Ulundia.

Ulundia Dist., Insect. Transvaal, i. p. 250 (1910).

189. *Ulundia madagascariensis.*

Elidiptera madagascariensis Sign., Ann. Soc. Ent. Fr. (3), viii. p. 199 (1860).

Ormenis madagascariensis Stål, Hem. Afric. iv. p. 243 (1866); Melich., Ann. Nat. Hofmus. xvii. p. 76, T. v. f. 19 (1902).

Loc. Aldabra: Takamaka, &c., x—xii. 1908 (Fryer).

This species was described by Signoret from Madagascar, and is also recorded by Melichar as from German East Africa. Another species is known from Natal (1910).

Genus Ketumala.

Ketumala Dist., Faun. Brit. Ind. Rhynch. iii. p. 446 (1906).

190. *Ketumala rubromarginata*, sp. n. (Plate **50**, fig. 2 *a*).

Body and legs very pale greenish (in older specimens ochraceous), more or less thickly greyishly tomentose; tegmina very pale greenish, or ochraceous, slightly

greyishly tomentose, costal margin very narrowly from beyond middle, apical margin, and inner margin to apex of clavus (more broadly), sanguineous; wings milky white; vertex of head including eyes narrower than pronotum, the anterior lateral angles a little acutely prominent; face a little broader than long with a central carination not quite reaching clypeus; pronotum anteriorly truncately produced; mesonotum with two discal carinations; tegmina twice as long as broad, costal margin not sinuate, apical margin subtruncate, costal membrane in some places wider than radial area; clavus distinctly granulose, the granules somewhat sanguineous; posterior tibiæ with two short spines beyond middle.

Long. excl. tegm. $6\frac{1}{2}$ mm. Exp. tegm. $18\frac{1}{2}$ to 19 mm.

Loc. Seychelles. Silhouette: Mont Pot-à-eau, high forest, over 1000 feet.

Genus Flatoides.

Flatoides Guér., Règn. Anim. Ins., p. 362 (1838); Dist., Faun. Brit. Ind. Rhynch. iii. p. 459 (1906).

191. *Flatoides protea*, sp. n. (Plate **50**, figs. 9 *a*, *b*).

Body above very pale virescent, inclining to pale ochraceous, abdomen above with the segmental margins greyishly tomentose; pronotum with three small discal black spots; mesonotum with six black spots of which the two lateral spots are the largest; body beneath and legs pale ochraceous, more or less greyishly tomentose; tegmina very pale virescent with a few darker and paler suffusions; wings creamy-white, the venation ochraceous; head including eyes distinctly narrower than pronotum at base; vertex longer than broad, somewhat attenuated towards apex, the lateral margins distinctly reflexed and with two small black spots on each side; face considerably longer than broad, a little concave, the lateral margins strongly ridged and a little concave at region of the eyes; tegmina about twice as long as broad, the costal membrane nearly three times as broad as radial area, the costal membrane and apical margin strongly veined; posterior tibiæ with two spines.

Var. Tegmina more ochraceous in hue with black suffusions as in fig. (9 *b*).

Long. excl. tegm. 8 mm. Exp. tegm. 18 mm.

Loc. Seychelles. Silhouette, from marshy plateau of Mare aux Cochons, about 1000 feet, and forest above. Mahé, from near Morne Blanc.

Subfamily **Delphacinæ**.

This subfamily is well represented in the present collection. I was only enabled to enumerate one species in the result of the former expedition; fourteen species comprised in five genera are now recorded.

Genus Pundaluoya.

Pundaluoya Kirk., J. Bomb. Nat. Hist. Soc. xiv. p. 52 (1902); Dist., Faun. Brit. Ind. Rhynch. iii. p. 467 (1906).

192. *Pundaluoya simplicia.*

Pundaluoya simplicia Dist., Faun. Brit. Ind. Rhynch. iii. p. 468, fig. 255 (1906).

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Loc. Seychelles. Mahé: near Morne Blanc; Mare aux Cochons district, 1000—2000 feet; Cascade, sea-level. Praslin: Côtes d'Or Estate. From grass, &c., in cultivated places.

This species is already proved to have a very wide distribution. I originally described it from Ceylon; since then it has been received from South Nigeria where it was found by Dr Lamborn breeding on the young shoots of *Kola* and *Cacao*. It is now to be also recorded from the Seychelles. The British Museum possesses a specimen from Hawaii named by the late Mr Kirkaldy as *Peregrinus maidis* Ashm., and his localities Fiji, New South Wales and Java probably also refer to *P. simplicia*.

193. *Pundaluoya pulchella*.

Pundaluoya pulchella Dist., Ann. Mag. Nat. Hist. (8), ix. p. 190 (1912); loc. cit. vi. p. 135, fig. 97 (1916).

Loc. Seychelles. Mahé: Cascade Estate, about 800 feet and over. Brit. India: Bengal, Travancore, Bombay. Ceylon.

OPICONSIVA, gen. nov.

Allied to *Pundaluoya* Dist. from which it differs in the elongate face, twice, or a little more than twice, longer than broad; vertex about as long or distinctly longer than broad; tegmina always quite three times longer than broad; posterior tibiæ with a short spine beyond middle, in addition to the inner long apical spur, and the short outer apical spine.

Type. *O. fuscovaria* Dist.

194. *Opiconsiva fuscovaria* (Plate **50**, fig. 10 *a*).

Head, pronotum and mesonotum castaneous, abdomen ochraceous with darker shadings; body beneath and legs ochraceous; tegmina pale shining, bronzy-brown, costal and apical margins (narrowly), and about the lower half of apical area fuscous, remaining inner half paler fuscous; wings hyaline, the veins fuliginous; head (including eyes) narrower than pronotum, antennæ brownish-ochraceous; face much longer than broad, marginally and medially strongly carinate, the medial carination bifurcate at base, obliquely narrowed near clypeus; mesonotum tricarinate; tegmina about three times longer than broad; posterior tibiæ with a long robust apical spine and a short spine beyond middle.

Long. excl. tegm. 3 mm. Exp. tegm. 11 to 11½ mm.

Loc. Seychelles. Silhouette: near Mont Pot-à-eau, and from Mare aux Cochons, over 1000 feet. Marie Anne Island. Mahé: Cascade Estate, 800—1000 feet; high forest of Morne Blanc; Anonyme Island. Found in the mountain-forests at considerable elevations, and also in drier forest vegetation near sea-level.

195. *Opiconsiva colorata*, sp. n. (Plate **50**, fig. 11 *a*).

Head, pronotum and mesonotum black; posterior angle of mesonotum and about basal half of abdomen above, ochraceous, apical half of abdomen black; body beneath and legs ochraceous; head and abdomen beneath black; tegmina subhyaline, the veins ochraceous, costal margin (narrowly), apical margin (slightly broader) and inner and

claval areas, more or less, dark fuscous; wings hyaline, the veins fuliginous; head (including eyes) narrower than pronotum, antennæ with the basal joint black, the second joint ochraceous; face much longer than broad, marginally and medially strongly carinate, the medial carination bifurcate at base, obliquely narrowed near clypeus; mesonotum tricarinate; tegmina about three times longer than broad; posterior tibiæ with a long robust apical spine and a short spine beyond middle.

Long. excl. tegm. 2 mm. Exp. tegm. 6 mm.

Loc. Seychelles. Silhouette: high country near Mont Pot-à-eau, about 1500 feet; Mare aux Cochons, plateau and jungle above; low coconut-planted country near the coast, Pointe Etienne. Mahé: from near Morne Blanc; Cascade Estate, 800—1000 feet, and forest above; marshes on coastal plain at Anse aux Pins and Anse Royale. Found in grasses, &c., in more open places in lower parts of mountain-forests.

196. *Opiconsiva balteata*, sp. n. (Plate **51**, fig. 8 *a*).

Vertex of head pale ochraceous, eyes black; pronotum and mesonotum pale castaneous-brown, both with a broad, longitudinal, pale ochraceous fascia, abdomen above black, its base and apex pale ochraceous; face and clypeus ochraceous, the former with the lateral areas black; sternum and legs ochraceous; tegmina subhyaline, the veins ochraceous; inner margin, scarcely reaching claval area, dark fuscous; wings subhyaline, the venation pale fuliginous; head (including eyes) narrower than pronotum; face much longer than broad, the posterior lateral margins distinctly rounded.

Long. excl. tegm. $2\frac{1}{2}$ mm. Exp. tegm. 6 mm.

Loc. Seychelles. Mahé: Cascade Estate, about 1000 feet; country above Port Glaud, 500—1000 feet.

By the coloration of the tegmina this species is allied to the two preceding species *O. fuscovaria* and *O. colorata*, but differs by the broad pale fascia to the pro- and mesonota, which character allies it to the two following species, *O. insularis* and *O. derelicta*, but from all these it is to be distinguished by the structure of the face, which is distinctly rounded posteriorly.

197. *Opiconsiva gloriosa*, sp. n.

Head, pronotum and mesonotum black; a broad, longitudinal central pale ochraceous fascia, occupying the whole central area of vertex and passing through pro- and mesonota; head beneath black; body beneath more or less black (imperfectly seen in unique carded specimen); legs ochraceous; tegmina black, the claval area paler and with two longitudinal black spots at apex, about two-thirds of posterior marginal area pale greyish subhyaline, the inner apical area palely blackish; the longitudinal pale ochraceous fascia more or less depressed, head including eyes narrower than pronotum; veins to tegmina moderately setigerous; vertex and face distinctly projecting beyond the eyes.

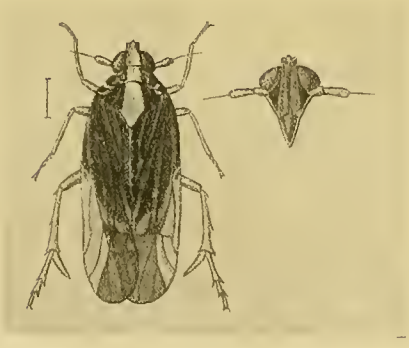


Fig. 3. *Opiconsiva gloriosa* Dist.

Long. incl. tegm. $5\frac{1}{2}$ mm.

Loc. Seychelles. Mahé: marshes on coastal plain at Anse aux Pins and Anse Royale.

A single specimen only contained in the collection.

198. *Opiconsiva insularis*, sp. n. (Plate **50**, fig. 12 *a*).

Vertex of head, pronotum and mesonotum pale shining greyish; antennæ and lateral areas of pro- and mesonota pale castaneous, those of the mesonotum darker; face, clypeus, rostrum and legs ochraceous; facial carinæ and a spot on each side of mesonotum, fuscous; abdomen beneath black with marginal ochraceous spots; tegmina pale ochraceous, the inner area pale fuscous; vertex somewhat narrow, distinctly extended before eyes, its apex truncate with a submarginal carination on each side; pronotum about as long as vertex; mesonotum longer than pronotum and vertex together; posterior tibiæ with a spine beyond middle and a long, robust apical spur; face a little more than twice longer than broad.

Long. incl. tegm. 3 mm.

Loc. Seychelles. Silhouette: low coconut-planted country near the coast, Pointe Etienne. Mahé: Cascade Estate, about 1000 feet.

199. *Opiconsiva derelicta*, sp. n. (Plate **50**, fig. 13 *a*).

Allied to *O. insularis* but the colour and markings much paler in hue; vertex of head a little longer and less truncate at apex; face slightly longer, the lateral margins not parallel, being distinctly narrowed before eyes.

Long. $3\frac{1}{2}$ mm.

Loc. Seychelles. Mahé: from lower country. A single specimen only is contained in the collection.

200. *Opiconsiva modesta*, sp. n. (Plate **50**, fig. 14 *a*).

Head, pronotum and mesonotum ochraceous; tegmina very pale ochraceous, with the venation darker; body beneath and legs ochraceous, abdomen beneath with basal and apical black spots; vertex a little longer than pronotum, projecting a little in front of eyes, the apex subtruncate; mesonotum prominently tricarinate; face twice as long as broad, a little narrowed before eyes; posterior tibiæ with a spine beyond middle and a long robust apical spur.

Long. 3 mm.

Loc. Seychelles. Mahé: Cascade, cultivated country near sea-level.

Genus Nilaparvata.

Nilaparvata Dist., Faun. Brit. Ind. Rhynch. iii. p. 473 (1906).

This genus was founded for the reception of a species from Ceylon. I am unable to generically separate the following species, though the antennæ are inserted at about middle of eyes and not beneath them, while the venation of the wings is setigerous, and the vertex not longer than broad.

201. *Nilaparvata mahensis*, sp. n. (Plate **51**, fig. 14 *a*).

Head ochraceous with three black punctate spots; pronotum very pale stramineous, with two central black spots; mesonotum castaneous, the carinations much paler; body beneath and legs ochraceous; tegmina subhyaline, the veins ochraceous and setigerous; vertex about as long as broad, lateral margins strongly carinate, their anterior angles moderately acutely prominent, two oblique discal carinations commencing at about middle of lateral margins and angularly meeting slightly in front of anterior margin, basal margin carinate; face elongate, very much longer than broad, centrally and laterally carinate, the central carination furcate at anterior margin; clypeus strongly, broadly, laterally and medially carinate, about half the length of face; antennæ inserted at about middle of eyes, second joint much longer than first, incrassate and granulose; pronotum about as long as vertex, centrally, laterally and anteriorly carinate; mesonotum distinctly tricarinate.

Long. 2 mm.

Loc. Seychelles. Mahé: Port Victoria, from grass in Botanic Gardens.

A single specimen only procured.

Consualia, gen. nov.

Head projecting beyond the eyes, centrally and laterally carinate, apical margin a little centrally produced; face elongate, slightly broadened before clypeus, centrally bicarinate, clypeus centrally and laterally carinate; antennæ with the first and second joints long and moderately robust, second a little longer than first; pronotum short, conically produced between the eyes, posterior margin prominent; mesonotum longer than head and pronotum together, with five longitudinal carinations, the three central longest and percurrent, the two lateral ones shorter and oblique; abdomen broad, robust, centrally ridged, the lateral margins flattened; posterior legs long, the tibiæ with a short spine near base, a longer spine beyond middle, and with a long robust apical spur; tegmina about twice as long as broad, apical margin convexly rounded, costal membrane without transverse veins, discal veins longitudinal, a series of transverse veins before apex deliminating apical cells, those at apical angle short and oblique; wings much shorter but almost as broad as tegmina, two transverse veins on upper disk.

202. *Consualia robusta*, sp. n. (Plate **50**, fig. 6 *a*).

Body dark castaneous; posterior angle of mesonotum, base and central longitudinal ridge to abdomen, and legs, more or less testaceous; tegmina pale brownish-ochraceous, the venation fuscous; wings pale fuliginous, the veins darker; structural characters as in generic diagnosis.

Long. excl. tegm. $5\frac{1}{2}$ mm. Exp. tegm. 10 mm.

Loc. Seychelles. Silhouette: near Mont Pot-à-eau, over 1000 feet.

Genus Ugyops.

Ugyops Guér., Voy. Ind.-Orient. Bélanger, Zool., p. 477 (1834); Syn. Dist., Trans. Linn. Soc. London, Zool. xiii. p. 44 (1909).

203. *Ugyops senescens* (Plate **49**, fig. 3 *a*).

Ugyops senescens Dist., Trans. Linn. Soc., Ser. 2, Zool. xiii. p. 44, Pl. **4**, figs. 16 *a*, *b* (1909).

Loc. Amirantes: Desroches Island, 1905. Seychelles: Mahé, Praslin, Silhouette, from near sea-level (not from the mountain-forests).

I have figured a variety in which the markings of the tegmina are darker and the basal joint of the antennæ paler than in the type previously delineated.

204. *Ugyops facialis*, sp. n. (Plate **49**, fig. 2 *a*).

Body above ochraceous; vertex of head with four black longitudinal lines; pronotum with a few dark spots on each lateral area; mesonotum with five longitudinal dark carinate lines which are usually black; abdomen spotted and suffused with castaneous, especially on disk and lateral margins; body beneath and legs ochraceous, face darker in hue and suffused with small paler and darker macular markings; tegmina subhyaline, the venation darker, the longitudinal veins considerably ochraceously broken, a series of longitudinal veins crossing disk of tegmina beyond middle and a few transverse veins before apex; wings hyaline, the venation fuscous; antennæ with the first and second joints ochraceous, about apical half of second, black; head with the central lobe distinctly prominent at apex, face long, narrow and prominent, extending for some distance before eyes, moderately widened from about anterior margin of eyes and again slightly narrowed before clypeus, central longitudinal ridge prominent, duplex for about anterior half, lateral margins distinctly reflexed; tegmina a little more than three times as long as broad.

Long. excl. tegm. 7 to 7½ mm. Exp. tegm. 20 mm.

Loc. Seychelles. Silhouette: near Mont Pot-à-eau, all over 1000 feet, and from Mare aux Cochons and forest above. Mahé: Mare aux Cochons district, over 1000 feet. Aldabra: 1908 (Fryer). In contrast to the preceding species, this species was found in the Seychelles at considerable elevations and in endemic-forest districts.

205. *Ugyops seychellensis*, sp. n. (Plate **49**, fig. 4 *a*).

Body and legs bright castaneous, lateral longitudinal sulcations to face, black; tegmina pale bronzy-brown, the veins darker, a few linear darker markings on claval vein; wings subhyaline, the veins fuliginous; head projecting a little beyond anterior margins of eyes; face elongate ampliated beyond eyes towards clypeus, prominently centrally longitudinally carinate, the lateral longitudinal black sulcations, profound; antennæ brownish-ochraceous, first and second joints robust; pronotum strongly centrally ridged; mesonotum with five longitudinal ridges; abdomen distinctly centrally ridged; tegmina with the veins more or less distinctly finely setigerous; posterior tibiæ with three distinct spines.

Long. excl. tegm. 5 to 5½ mm. Exp. tegm. 14 mm.

Loc. Seychelles. Mahé: high forest of Morne Blanc and Pilot, circa 2000 feet; slopes of Morne Seychellois, 1500—2000 feet.

AMBARVALIA, gen. nov.

Vertex of head considerably produced in front of eyes, about as far as from anterior margins of eyes to base of head, a little widened on apical area, centrally longitudinally carinate, the carination becoming bifid in front of eyes, the margins elevately carinate, face prominently extended in front of eyes, apex somewhat conically rounded, widened towards posterior margin, centrally longitudinally carinate; clypeus short, broad, less than half the length of face, centrally carinate; antennæ with the first and second joints distinctly incrassated, second much longer than first; pronotum only a little shorter than mesonotum, strongly tricarinate; mesonotum tricarinate, the disk moderately raised and flattened; posterior tibiæ with a strong apical spur which is serrate on its inner margin; tegmina four times longer than broad, veins longitudinal, on inner margin of apical area are two short oblique veins.

I have only seen one carded specimen of this very interesting genus, the details of the under surface being thus indescribable.

206. *Ambarvalia pyrops*, sp. n. (Plate **51**, fig. 1 *a*).

Black; the carinations to vertex, pro- and mesonota obscurely ochraceous, the posterior margins of the latter two being also more or less finely spotted with the same colour; tegmina finely spotted with greyish and ochraceous, the apical area unspotted; anterior and intermediate tibiæ basally and apically annulated with ochraceous, apex of posterior tibiæ including the apical spur ochraceous, posterior tarsi with the apex of first joint and the whole of second joint, ochraceous; structural characters as in generic diagnosis.

Long. 4 mm.

Loc. Seychelles. Mahé, near Morne Blanc, about 1000 feet.

Family **Cercopidæ.**

Only one species belonging to this family is contained in the collection. It is in the Ethiopian region that the genus which contains this species is more largely represented and Madagascar contributes its largest and most showy species.

Subfamily **Aphrophorinæ.**

207. *Ptyelus mahei.*

Ptyelus mahei Dist., Trans. Linn. Soc., Ser. 2, Zool. xiii. p. 45, Plate **4**, fig. 14 *a* (1909).

Loc. Seychelles. Silhouette: near Mont Pot-à-eau, over 1000 feet; highest forest, over 2000 feet; Mare aux Cochons, about 1000 feet. Mahé: from near Morne Blanc and high forest of same; high damp forest at summit of Pilot, over 2000 feet; high damp forest between Trois Frères and Morne Seychellois, about 1500—2000 feet; Cascade Estate, 800—1000 feet; forest near Mount Harrison, 1700 feet.

In high damp forests, often sitting on palm leaves, &c. (Hugh Scott).

A variable species in coloration; sometimes the pale central spot to tegmina, before the apical area (see fig.), is obsolete, or entirely absent; the colour of the tegmina also varies from piceous-brown to either brownish-ochraceous or blackish.

Family **Jassidæ.**

Subfamily **Bythoscopinæ.**

This subfamily is represented by five* genera, three of which are found in the Indian fauna, and two described for the first time may also eventually prove to belong to that region. *Nehela* is represented by eight species. The Hawaiian Islands appear to possess only one genus, *Bythoscopus*.

Genus Idiocerus.

Idiocerus Lewis, Trans. Ent. Soc. Lond. i. p. 47 (1836); Dist., Faun. Brit. Ind. Rhynch. iv. p. 184 (1907).

208. *Idiocerus scotti*, sp. n.

Vertex of head pale greenish-ochraceous; pronotum and scutellum more virescent, the former with a small black spot near each lateral margin (in some varietal forms with two central spots also), the latter with two small black spots on basal margin; body beneath and legs pale greenish-ochraceous; tegmina olivaceous-brown, costal area very pale greenish-ochraceous and containing a large prominent black spot near middle, extreme costal margin bright olivaceous-green; face with a slightly darker spot at anterior margin and a longer similar spot from eyes to base of clypeus; a somewhat elongate species; vertex of head nearly three times as broad as long, front, including face, about as long as broad; apices of the joints to posterior tarsi, black.

Fig. 4. *Idiocerus scotti* Dist.

Long. incl. tegm. 4 to $4\frac{1}{2}$ mm.

Loc. Seychelles. Silhouette: near Mont Pot-à-eau; Mare aux Cochons, plateau and jungle near by. Mahé: Cascade Estate, about 1000 feet. Praslin: Côtes d'Or Estate, especially from Coco-de-Mer forest in the Vallée de Mai. Félicité Island: from forest.

Kronos, gen. nov.

Vertex of head slightly more than twice as broad as long, rounded in front, moderately obliquely depressed; face globosely depressed, broader than long, lateral margins concavely sinuate, narrow and truncate before clypeus, which is narrow and about two-thirds the length of face; ocelli much nearer eyes than to each other; pronotum obliquely, anteriorly depressed, and moderately raised on disk, about twice as broad at base as long; scutellum about twice as broad at base as long, broadly

* *Galboa typica* Dist. (Trans. Linn. Soc. London, Zool. xiii. p. 46, Pl. 4, fig. 11 (1909)) was described from the first collection made by Prof. Gardiner (Mahé) but was not contained in the larger collection here described.

foveately excavate on disk; posterior tibiæ thickly, strongly spinulose; tegmina more than twice as long as broad, a few transverse veins on costal membrane beyond middle, three apical cells.

Allied to *Bythoscopus* but differs by the globose and differently constructed face, foveate scutellum, &c.

209. *Kronos typicus*, sp. n.

Vertex of head, pronotum and scutellum ochraceous, the last much paler in hue and with a darker spot near each basal angle; body beneath and legs ochraceous; apices of the posterior tibiæ and the posterior tarsi—excluding base—fuscous; tegmina brownish-ochraceous, with some small dark spots on claval margin, narrow apical margin distinctly darker; face and clypeus ochraceous; cheeks more or less spotted with black; structural characters as in generic diagnosis.

Fig. 5. *Kronos typicus* Dist.

Long. incl. tegm. 4½ mm.

Loc. Seychelles. Mahé: from near Morne Blanc and high forest of Morne Blanc and Pilot.

A probably scarce species as the collection only contained two examples.

Genus Bythoscopus.

Bythoscopus Germ., in Silberm., Rev. Ent. i. p. 180 (1833); Syn. Dist., Faun. Brit. Ind. Rhynch. iv. p. 190 (1907).

210. *Bythoscopus indicus.*

Macropsis indica Leth., Bull. Soc. Zool. Fr. 1892, p. 209.

Pachyopsis chlorophana Melich., Hom. Faun. Ceylon, p. 153 (1903).

Bythoscopus indicus Dist., Faun. Brit. Ind. Rhynch. vi. p. 227 (1916).

Loc. Seychelles. Silhouette: Mare aux Cochons. Also found in Ceylon, Brit. India, and Tenasserim.

A single specimen only secured.

Genus Nehela.

Nehela Buch. White, Proc. Zool. Soc. 1878, p. 473; Dist., Faun. Brit. Ind. Rhynch. vi. p. 231 (1916).

Pachynus Stål, Hem. Afr. iv. p. 127 (1866), nom. præocc.

Igerna Kirk., Wien. ent. Zeit. xxii. p. 13 (1903), n. nom.

Stål's name *Pachynus* was preoccupied, but its synonym *Nehela* Buch. White is available, and Kirkaldy's new name is therefore not required. The genus is very widely distributed, the type being from St Helena; it is also found throughout tropical Africa, and British India and Ceylon. Mr Hugh Scott found this genus very abundant in the mountain-forests; it appears entirely confined to the endemic forest.

Melichar has recently described and figured a Javan species under the name of *Oncopsis nigritus* (Notes Leyden Mus. xxxvi. p. 121, Pl. 3, fig. 9) which should either be included in *Nehela*, or otherwise that generic name should give place to *Oncopsis* Burm. (1837). But as Burmeister gives as typical *Oncopsis* the *lanio* Linn., it cannot very well apply to *nigritus* Melich. which I regard as an undoubted *Nehela*.

211. *Nehela bimaculicollis* (Plate **51**, fig. 25 *a*).

Bythoscopus (*Oncopsis*) *bimaculicollis* Stål, Öfv. Vet.-Ak. Förh. 1855, p. 100.

Pachynus bimaculicollis Stål, Hem. Afr. iv. p. 127 (1866); Melich., Wien. ent. Zeit. xxiv. p. 297 (1905).

Agallia quadrinotata Melich., Hom. Ceylon, p. 151 (1903).

Igerna bimaculicollis Jacobi, Kilimandjaro-Meru Exped. 12 (7), p. 129, T. 11, fig. 28 (1910).

Nehela bimaculicollis Dist., Faun. Brit. Ind. Rhynch. vi. p. 232 (1916).

Loc. Seychelles. Silhouette: forest above Mare aux Cochons. Mahé: Cascade Estate, forest, above 1000 feet; Anonyme Island. Also found in Ceylon, Brit. India, and in East and South Africa.

Jacobi's figure (supra) appears, at least, to represent a variety?

212. *Nehela spectabilis*, sp. n. (Plate **51**, fig. 27 *a*).

Ochraceous; two spots on vertex of head, an oblique line on each side of pronotum from inner margins of eyes and two large spots at base of same, a spot at each basal angle of the scutellum, and a broad submarginal fascia to the tegmina—united to the margin near base—black; body beneath and legs ochraceous; face with two spots on apical margin, an oblique spot behind eyes, followed by an elongate spot on each side before clypeus, three spots on disk, and a central fascia to clypeus, black; sternum and base of abdomen black; structure of face better shown by the figure here given.

Long. incl. tegm. 5 mm.

Loc. Seychelles. Mahé: Mare aux Cochons district, 1000—2000 feet.

A single specimen of this handsome species was alone found in this collection.

213. *Nehela elegantula*, sp. n. (Plate **51**, fig. 24 *a*).

Ochraceous; two spots on vertex nearly equidistant from eyes and from each other, between them a central longitudinal line, a large spot on each side of pronotum before middle, between them a central longitudinal fascia, and a curved anterior fascia on each side behind eyes, a spot at each basal angle of scutellum and a transverse spot on disk; tegminal veins and a very broad submarginal fascia, two anterior marginal spots to face and two smaller spots beneath them, a curved marginal spot on each side behind eyes and a spot at apex of clypeus, black; vertex of head narrow, subconically rounded anteriorly; anterior tibiæ and tarsi pale fuscous.

Long. incl. tegm. 5 mm.

Loc. Seychelles: a fairly long series, entirely from the endemic forests. Silhouette: Mare aux Cochons, plateau and forest above, about 1500 feet. Mahé: country above Port Glaud, about 500—1000 feet; high damp forest at summit of Pilot, over 2000 feet;

from near Morne Blanc; slopes of Morne Seychellois, about 1500—2000 feet. Praslin: Côtes d'Or Estate.

In some specimens the thoracic markings are diminished in size, but in all examples the broad black submarginal fascia to the tegmina is constant.

214. *Nehela conspicua*, sp. n. (Plate **51**, fig. 26 *a*).

Vertex of head pale ochraceous with two large central black spots; pronotum, scutellum and tegmina black, a central spot and posterior lateral margins to scutellum and inner margins to tegmina pale ochraceous; face black, anterior margin—including two black spots—a spot on each side before eyes, and the posterior lateral margins, pale ochraceous; legs and abdomen beneath pale ochraceous, the latter with transverse black fasciæ, apices of anterior tibiæ and tarsi blackish.

Long. incl. tegm. 4½ to 5 mm.

Loc. Seychelles. Mahé: Cascade Estate, about 1000 feet; Mare aux Cochons district, 1000—2000 feet.

215. *Nehela lineoligera*, sp. n.

Vertex of head dull ochraceous with two prominent black spots; pronotum piceous or blackish, the posterior margin and two small discal spots on each side ochraceous, a large darker black spot on each side behind eyes; scutellum blackish, the lateral margins pale ochraceous; body beneath and legs ochraceous, anterior tibiæ and tarsi, apices of intermediate tibiæ and tarsi, and apices of posterior tarsi, black; tegmina blackish, costal margin, a distinct central longitudinal fascia, and the veins—more or less—very pale ochraceous or greyish; face imperfectly seen in unique carded specimen.

Fig. 6. *Nehela lineoligera* Dist.

Long. incl. tegm. 5 mm.

Loc. Seychelles. Silhouette: high country near Mont Pot-à-eau.

216. *Nehela scutellata*, sp. n. (Plate **51**, fig. 28 *a*).

Black; anterior margin of vertex (excluding centre), a spot before eyes, narrow posterior margin to pronotum, the scutellum, interior margins of tegmina, body beneath and legs, ochraceous; face with anterior margin, a spot near inner margin of each eye, and a central fascia to clypeus, black.

Long. incl. tegm. 4 mm.

Loc. Seychelles. Mahé: slopes of Morne Seychellois, about 1500—2000 feet.

A single specimen of this species only received. Apart from its distinct coloration and markings the structure of the face is very distinct, and this is better shown by the figure than by the less satisfactory method of a detailed description.

217. *Nehela flavolineata*, sp. n. (Plate **51**, fig. 23 *a*).

Black; longitudinal, fasciate spots to vertex of head, two minute discal spots and posterior submarginal fascia to pronotum, lateral margins of scutellum, inner and

lateral margins and veins to tegmina, head beneath, sternum and legs, ochraceous; face with a short central longitudinal fascia, a spot on each side of anterior margin, a large spot on each side behind eyes and apex of clypeus, black; anterior tibiæ fuscous; vertex of head more evenly rounded than in preceding species.

Long. incl. tegm. 4½ mm.

Loc. Seychelles. Silhouette: near Mont Pot-à-eau, highest forest, over 2000 feet; Mare aux Cochons, plateau and forest above. Mahé: top of Mount Sebert, nearly 2000 feet.

A superficial but constant characteristic of this species is the posterior pale submarginal fascia to the pronotum.

218. *Nehela aterrima*, sp. n. (Plate **51**, fig. 22 *a*).

Head above, pronotum, scutellum and tegmina black, vertex with fine obscure yellowish streaks on each side near eyes; lateral margins of scutellum and outer and inner margins of tegmina pale ochraceous; body beneath and legs pale ochraceous, face with a transverse anterior marginal fascia (sometimes broadly centrally longitudinally continued as in figure, or with the anterior transverse fascia only), anterior tibiæ, apices of anterior tarsi, and transverse abdominal fasciæ, black.

Allied to the preceding species *N. flavolineata* from which it differs by the different structure and markings of the face as shown in figures, smaller size, and more melanic coloration.

Long. incl. tegm. 4 mm.

Loc. Seychelles. Silhouette: near Mont Pot-à-eau, over 1000 feet, Mare aux Cochons, plateau and jungle above. Mahé: high forest of Morne Blanc; country above Port Glaud, about 500—1000 feet; high damp forest at summit of Morne Pilot, over 2000 feet; Mare aux Cochons district, 1000—2000 feet; Cascade Estate, forest, above 1000 feet, and forest near Mount Harrison, 1700 feet; slopes of Morne Seychellois, about 1500—2000 feet. Félicité Island: from forest. Very numerous throughout the mountain-forests of Mahé and Silhouette.

Subfamily **Tettigoniellinæ.**

This subfamily is represented by four genera, two of which are described for the first time, the other two being originally recorded from British India where the Tettigoniellinæ are well represented. The Seychelles with only four genera and five species are poorly illustrative of the subfamily in which the Oriental region is so rich, and the Ethiopian region more moderately opulent. In the "Fauna Hawaiiensis," Kirkaldy only enumerates one species and that one he had not seen himself.

Genus Kolla.

Kolla Dist., Faun. Brit. Ind. Rhynch. iv. p. 223 (1907).

This genus has a very wide distribution and is found in the Ethiopian, Oriental, Australasian and Neotropical regions, especially in the last.

219. *Kolla seychellensis*, sp. n.

Head, pronotum, scutellum, body beneath and legs, flavescent; vertex with two prominent black spots on anterior margin; face—excluding a short discal central line and the lateral margins—pale brownish-ochraceous, with darker transverse striations; tegmina greyish-subhyaline, the inner area reflecting the dark abdomen beneath; vertex a little more than half as long as breadth between eyes, a very fine central carinate longitudinal line; ocelli near base, about as near to each other as to eyes; face longer than broad, the lateral margins a little concave near eyes.

Fig. 7. *Kolla seychellensis* Dist.

Long. incl. tegm. 4 mm.

Loc. Seychelles. Mahé: Cascade Estate, 800—1000 ft.; Port Victoria, from grass in Botanic Gardens; marshes on coastal plain at Anse aux Pins and Anse Royale; Cascade, cultivated country near sea-level.

220. *Kolla funeralis*, sp. n.

Head, pronotum, scutellum, body beneath and legs, flavescent, vertex with two prominent black spots on anterior margin; scutellum with a darker spot near each basal angle; tegmina greyish, claval area somewhat bluish-grey, followed by a broad black longitudinal fascia which reaches apex, extreme costal margin flavescent; vertex only a little less in length than breadth between eyes, apical margin distinctly conical, a central carinate line not reaching apex, the ocelli near base, a little nearer to eyes than to each other; scutellum transversely impressed near base.

Fig. 8. *Kolla funeralis* Dist.

Long. incl. tegm. 3 mm.

Loc. Seychelles. Silhouette: Mare aux Cochons, from marshy plateau and forest above; low coconut-planted country near the coast, Pointe Etienne. Mahé: country above Port Glaud, about 500—1000 feet, and near Morne Blanc.

Maiestas, gen. nov.

Allied to the genus *Kolla* Dist. in the general structure of the head, save that the ocelli are placed near the base and almost as near to eyes as to each other; another chief difference is in the venation of the tegmina which contains two transverse veins on disk, one near base, the other near middle, four large apical cells and three narrow ante-apical cells or areas.

221. *Maiestas illustris*, sp. n.

Vertex of head pale ochraceous, with two broad central longitudinal pale castaneous fasciæ and a similarly coloured short longitudinal line between them; pronotum pale ochraceous with six pale castaneous fasciæ of which the central two are largest and curved; scutellum with a small black spot near each basal angle, with two pale spots between and one beyond them; body beneath and legs ochraceous, the basal area of abdomen sometimes shaded with piceous; tegmina ochraceous, when closed reflecting the dark dorsal surface of the abdomen beneath them, the veins greyish-white, the apical cells more or less spotted or suffused with black; anterior and intermediate femora and tibiæ annulated with pale brownish; vertex of head about as long as breadth between eyes, longly produced and narrowed before eyes, the basal margin moderately concave; face longer than broad, from near anterior margins of eyes obliquely narrowed both anteriorly and posteriorly, finely transversely striate on each lateral area; pronotum about twice as broad as long, truncate posteriorly, convex anteriorly; scutellum about twice as broad at base as long.

Fig. 9. *Maiestas illustris* Dist.

Long. incl. tegm. 3½ mm.

Loc. Seychelles. Silhouette: Mare aux Cochons, and forest near by and immediately above. Mahé: near Morne Blanc, country above Port Glaud, about 500—1000 feet; Cascade Estate, 800—1000 feet.

Genus Ujna.

Ujna Dist., Faun. Brit. India, Rhynch. iv. p. 239 (1907).

This genus was founded for two species from British India, one from Ceylon, the other from Tenasserim. The present species here described is the largest representative of the genus I have as yet examined.

222. *Ujna flavidipes*, sp. n. (Plate **51**, fig. 20 *a*).

Head, pronotum, scutellum and tegmina black, the latter with a pale ochraceous costal marginal spot at about one-third before apex; body beneath and legs pale stramineous; vertex of head broadly elongate, about as long as breadth between eyes, ocelli on disk in a line a little before the anterior margins of the eyes; face long, distinctly longitudinally carinate for less than half its length, very indistinctly carinate on the remaining area; pronotum shorter than vertex, lateral margins straight; scutellum about as long or very slightly longer than pronotum, distinctly transversely impressed before apex.

Long. incl. tegm. 5 mm.

Loc. Seychelles. Mahé: from near Morne Blanc; Cascade Estate, forest, above 1000 feet, and forest near Mount Harrison, 1700 feet; Mare aux Cochons district, 1000—2000 feet.

Paganalia, gen. nov.

Head nearly twice as broad between eyes as long, triangularly produced before eyes, ocelli near base, much closer to eyes than to each other; face about twice as long as broad, narrow, centrally compressed, about three times as long as clypeus; pronotum a little longer than vertex or scutellum, anteriorly narrowed and convexly produced, the apical and posterior margins truncate; scutellum much broader than long, basal margin longer than either of the lateral margins; tegmina considerably passing abdominal apex, veins simple and longitudinal. Allied to the Nearctic and Neotropical genus *Helochara*.

223. *Paganalia virescens*, sp. n.

Dull virescent, apical areas of the tegmina irregularly pale fuscous-brown; body beneath virescent, legs pale ochraceous, anterior and intermediate tibiæ obscurely annulated with pale fuscous, posterior tibiæ outwardly margined with small blackish spots at the bases of the spinules; eyes black, their inner margins beneath sanguineous; structural characters as in generic diagnosis.

Long. incl. tegm. 6 mm.

Loc. Seychelles. Mahé: Long Island.

Fig. 10. *Paganalia virescens* Dist.

Subfamily **Jassinæ.**

This subfamily is not so largely represented in the collection as might have been expected. The species are contained in eight genera, six of which have a wide distribution, and only two have had to be considered as previously undescribed.

Two species, *Chelusa seychellensis* Dist., and *Athysanus insularis* Dist., previously brought home by Prof. Gardiner, and described in these Transactions (1909), were unrepresented in this much larger collection.

Genus Acropona.

Acropona Melich., Hom. Faun. Ceylon, p. 168 (1903); Dist., Faun. Brit. Ind. Rhynch. iv. p. 300 (1908).

224. *Acropona prasina* (Plate **51**, fig. 17 *a*).

Gypona prasina Walk., List Hom. Suppl., p. 258 (1858).
Acropona prasina Melich., Hom. Faun. Ceylon, p. 168 (1903).
? Walkeri Kirk., Entomologist, xxxiii. p. 294 (1900).
Eogypona walkeri Kirk., l.c. xxxiv. p. 39 (1901).

Loc. Seychelles. Silhouette: from highest forest, over 2000 feet. Mahé: Cascade Estate, 800—1000 feet; top of Mount Sebert, nearly 2000 feet. Praslin: Côtes d'Or Estate. Originally described from Ceylon, and also recorded from the Maldives*.

225. *Acropona gardineri*, sp. n. (Plate **51**, fig. 21 *a*).

Above bright olivaceous-green; body beneath and legs pale green; anterior margin of vertex of head and subanterior margin of face, continued on each side to near eyes, sanguineous; differs from the preceding species, *A. prasina*, by the darker olivaceous-green coloration above, the sanguineous apical fasciæ to vertex and face; vertex of head a little shorter; pronotum with a more or less distinct transverse impression before middle.

Long. incl. tegm. 10 to 12 mm.

Loc. Seychelles. Mahé: Cascade Estate, about 1000 feet; from forest of rather stunted Capucin trees (*Northea*) on summit of "Montagne Anse Major," 2000 feet or over. Praslin: Côtes d'Or Estate.

226. *Acropona sladeni*, sp. n. (Plate **51**, fig. 19 *a*).

Body above dark sanguineous, body beneath and legs pale sanguineous; anterior margin of vertex narrowly ochraceous, anterior margin of face ochraceous, subanterior margin dark sanguineous; apart from the different coloration this species differs from the two preceding by the broader, and laterally more sinuate face; the scutellum also possesses two distinct longitudinal ridges with a posteriorly transverse convex impression between them.

Long. incl. tegm. 11 mm.

Loc. Seychelles. Praslin: Côtes d'Or Estate.

Genus Jassus.

Jassus Fabr., Syst. Rhyng., p. 85 (1803); Syn. &c., Dist., Faun. Brit. Ind. Rhynch. iv. p. 327 (1908).

227. *Jassus indicus* (Plate **51**, fig. 13 *a*).

Cælidia indica Walk., List Hom. iii. p. 855 (1851).

Tettigonia jactans Walk., l. c. Suppl., p. 357 (1858).

Jassus deplanatus Spangb., Öfv. Vet.-Ak. Förh. 1878, no. 8, p. 23.

Jassus indicus Dist., Faun. Brit. Ind. Rhynch. iv. p. 327; fig. 210 (1908); Trans. Linn. Soc. Zool. xiii. p. 46 (1909).

Loc. Seychelles: though not a native species, this was found largely in the high endemic mountain-forests. Silhouette; near Mont Pot-à-eau, over 1000 feet; Mare aux Cochons, marshy plateau and jungle above. Mahé: from near Morne Blanc; from grass in cultivated country, about 1000 feet; Cascade Estate, 800—1000 feet; top of Mount Sebert, nearly 2000 feet; Mare aux Cochons district, 1000—2000 feet. Also found

* I have it recorded in my journal that a number of specimens of *Acropona* were taken in a particular dry, scrubby type of forest-vegetation, which is found especially in connection with areas of bare granite "glacis." The *Acropona* were obtained thus in Mahé (Cascade Estate) and in a valley behind Grande Anse, Praslin. But whether these statements refer to *A. prasina* and *A. gardineri* equally, or to one more than the other, is very hard to say.—H. Scott.

widely distributed in Brit. India, Burma and Tenasserim. The specimen here figured is of a varietal character, but one which is also found in India. I have (supra, 1908) described the variation of the species.

228. *Jassus determinatus*, sp. n. (Plate **51**, fig. 16 *a*).

Closely allied to *J. indicus*, but with the face testaceous with a broad central longitudinal black fascia which neither reaches base nor apex, cheeks with a prominent black spot on each side; rostrum and legs ochraceous, apex of rostrum, apices of posterior tibiæ and apices of all the tarsi, black; posterior tibiæ finely spotted with black.

Long. incl. tegm. 7 mm.

Loc. Seychelles. Mahé: Cascade Estate, about 1000 feet.

A single carded specimen of this distinctly marked and coloured species.

Limentinus, gen. nov.

Allied to *Jassus*, but with the vertex of head distinctly longer than broad, the apex considerably broader than base, rounded, and distinctly projecting beyond the anterior margins of the eyes, strongly centrally and laterally carinate, ocelli near apical margin, much farther apart from each other than from the lateral apical angles; face very long, about as long as vertex, pronotum and scutellum together, elongate, very slightly convex, its anterior margin distinctly produced beyond the anterior margin of the eyes; scutellum small, centrally carinate, less than half the length of face; other characters generally as in *Jassus*.

229. *Limentinus aldabranus*, sp. n. (Plate **51**, fig. 12 *a*).

Vertex of head ochraceous, black between the carinations; pronotum and scutellum black; body beneath and legs ochraceous; face and clypeus with broad lateral black fasciæ; apices of the posterior tibiæ black; tegmina dull dark ochraceous, the venation broadly black, costal membrane black, with a longitudinal line before middle, and two prominent longitudinal spots beyond middle, pale ochraceous, the veins on apical area spotted with pale ochraceous, claval veins also finely spotted with ochraceous; pronotum obscurely transversely strigose; scutellum strongly transversely impressed near middle; other structural characters as in generic diagnosis.

Long. 8 mm.

Loc. Aldabra: Esprit I. (Fryer).

Genus *Athysanus*.

Athysanus Burm., Gen. Ins. I. t. xiv. subj. 2 (1840).

Of this widely distributed genus only one species is contained in the collection and is here described. Another, *A. insularis* Dist., formerly brought home by Prof. Gardiner from the Amirantes, is not here included.

230. *Athysanus frontalis*, sp. n.

Pale flavescent, the tegmina subhyaline; vertex of head with an angulate black linear fascia between the eyes; anterior and intermediate femora biannulated with black, extreme apices of posterior femora, and apices of joints of posterior tarsi, black or blackish; anterior third of face regularly blackly transversely striate with a central longitudinal ochraceous spot, remaining area reticulately blackly striate; clypeus with the lateral margins black; body beneath more or less shaded with black; face elongate, about as long as breadth between eyes; vertex of head subconically produced before eyes; head with the eyes somewhat wider than the pronotum.

Fig. 11. *Athysanus frontalis* Dist.

Long. incl. tegm. 4½ to 5 mm.

Loc. Seychelles. Mahé: Port Victoria, from grass in Botanic Gardens; Cascade Estate, 800—1000 feet; low country—various localities.

MATSUMURANA, gen. nov.

Head much broader than long, convexly rounded before eyes, which posteriorly overlap the anterior lateral margins of the pronotum; face broad and moderately globose, its lateral margins convexly rounded, about as broad as long; clypeus about half the length of face; pronotum about twice the length of vertex, anterior margin convex between the eyes, posterior margin truncate; scutellum shorter than pronotum, moderately transversely impressed before apex; tegmina about three times as long as broad, apices moderately narrowed and rounded, lateral margins convex, claval area broad, three apical cells; posterior tibiæ longly spinulose outwardly, more shortly and finely spinulose inwardly.

Allied to *Dagama* Dist., a genus at present only recorded from Natal, from which it differs by the more conically produced vertex in front of eyes, the broader and shorter face, and by having only three apical cells to tegmina; it also has affinities with *Mimotelliæ* Mats.

231. *Matsumurana facialis*, sp. n.

Above cinnamomeous-brown; vertex of head with three more or less distinct narrow pale ochraceous transverse fasciæ, the extreme anterior margin also of that colour; pronotum with four transverse pale ochraceous fasciæ; scutellum with a dark spot near each basal angle, and four pale spots, two near anterior margin, and one on each lateral margin; tegmina with paler suffusions and some irregular black spots, of which the principal are three oblique spots on each lateral margin, a spot at apex of clavus, the apical areas also black; apical area of abdomen above black; structural characters as in generic diagnosis.

Fig. 12. *Matsumurana facialis* Dist.

Long. 3½ mm.

Loc. Seychelles. Silhouette: forest above Mare aux Cochons. Mahé: country above Port Glaud, about 500—1000 feet.

Genus Balclutha.

Gnathodus Fieb., Verh. z.-b. Ges. Wien, xvi. p. 504 (1866), nom. præocc.

Balclutha Kirk., Entomologist, xxxiii. p. 243 (1900), nom. n.

An almost universally distributed genus.

232. *Balclutha chersonesia*, sp. n.

Bright golden-yellow, tegmina much paler except on claval area; scutellum with a dark spot near each basal angle; ocelli near the eyes distinctly visible near passage of vertex to front; vertex with a narrow central longitudinal line; face with a distinct central longitudinal line and the lateral margins pale, the striated area more pale piceous; scutellum distinctly transversely impressed.

Fig. 13. *Balclutha chersonesia* Dist.

Long. incl. tegm. 3½ to 4 mm.

Loc. Seychelles. Silhouette: Mare aux Cochons, and forest near by; low coconut-planted country near the coast, Pointe Etienne. Mahé: from near Morne Blanc; country above Port Glaud, about 500—1000 feet; Cascade Estate, 800—1000 feet; Anonyme Island; marshes on coastal plains at Anse aux Pins and Anse Royale.

233. *Balclutha varicolor*, sp. n.

Head and scutellum dark ochraceous; pronotum and tegmina pale greenish-ochraceous; abdomen above black, the segmental margins and apex ochraceous; body beneath and legs ochraceous; tegminal veins mostly paler in hue; vertex of head with a central longitudinal ridge; pronotum moderately arched and centrally ridged; scutellum distinctly transversely impressed.

Fig. 14. *Balclutha varicolor* Dist.

Long. incl. tegm. 3 to 3½ mm.

Loc. Seychelles. Silhouette: Mare aux Cochons; low coconut-planted country near the coast, Pointe Etienne. Mahé: near Morne Blanc, about 1000 feet; from grass in cultivated country, about 1000 feet.

Genus Scaphoideus.

Scaphoideus Uhler, Trans. Maryl. Ac. Sci., p. 33 (1888).

This very widely distributed genus has three representatives in the Seychelles.

234. *Scaphoideus vagans*, sp. n.

Very pale ochraceous; vertex of head with six small brown submarginal spots arranged in pairs, a central arcuate pale brownish fascia containing two dark spots, and two pale brownish subquadrate spots on the basal area; pronotum with four basal spots, two small central discal spots, and an arcuate broken narrow fascia near anterior margin, all pale brownish; scutellum with pale brownish markings and a dark spot on each lateral margin; tegmina with linear blackish markings, more pronounced on apical area where they are more numerous and smaller; face with dark transverse fasciæ for about two-thirds its length, cheeks with two dark oblique lines on each side; abdomen beneath more or less shaded with black; vertex of head about as long as breadth between eyes, transversely depressed near middle; pronotum about as long, or only slightly longer than scutellum, the latter with a distinct curved central impression.

Fig. 15. *Scaphoideus vagans* Dist.

Long. incl. tegm. 3 mm.

Loc. Seychelles. Silhouette: Mare aux Cochons, and forest near by. Mahé, country above Port Glaud, about 500—1000 feet; Port Victoria, from grass in Botanic Gardens and from grass in cultivated country; Cascade Estate, 800—1000 feet; Mare aux Cochons district, 1000—2000 feet; Cascade, cultivated country near sea-level; forest near Mount Harrison.

From grass &c. in cultivated places.

235. *Scaphoideus tessellatus*, sp. n.

Very pale ochraceous; vertex of head with four very pale brownish apical marginal spots, and a cluster of about six dark brown spots on disk; pronotum with two dark brown spots on anterior margin and blackish transverse linear markings on disk; scutellum very pale, a blackish spot near each basal angle, and some small dark spots on discal and apical areas; tegmina very much tesselated with blackish linear markings, of which the most prominent are spots on costal and claval margins near bases; head beneath very pale with a slight virescent tint, face with obscure darker transverse striations; body beneath and legs very pale ochraceous; abdomen with black suffusions, especially on apical area; posterior legs with femoral streaks, apices of tibiæ and bases of spinules, black, the tibiæ also blackly annulate; face much longer than breadth between eyes; scutellum about as long as pronotum; vertex of head about as long as breadth between eyes.

Fig. 16. *Scaphoideus tessellatus* Dist.

Long. incl. tegm. 5 mm.

Loc. Seychelles. Silhouette: Mare aux Cochons, plateau and jungle near by and forest above. Mahé: from near Morne Blanc, and Mare aux Cochons district.

A species taken in high forest.

236. *Scaphoideus seychellensis*, sp. n.

Body, tegmina and legs pale ochraceous; vertex of head with six small anterior submarginal spots and a T-shaped spot on disk, fuscous-brown, the surrounding areas of these spots greyish-white; pronotum with greyish-white suffusions; scutellum with the whole central area greyish-white, and with an ochraceous spot near each basal angle; face with a series of dark transverse linear spots on each lateral area, larger and nearly meeting between eyes; tegmina with the veins paler, and with testaceous spots on anterior half and at apical margin; vertex about as long as breadth between eyes; scutellum about as long as pronotum; face much longer than broad, very slightly concave near eyes, narrowed and slightly rounded towards clypeus.

Fig. 17. *Scaphoideus seychellensis* Dist.

Long. incl. tegm. $3\frac{1}{2}$ mm.

Loc. Seychelles. Silhouette: Mare aux Cochons.

A single example.

Genus Paralimnus.

Paralimnus Matsum., Termész. Füzetek, xxv. p. 386 (1902).

Distributed in the Eastern Palæarctic, Oriental, Malayan and Australasian regions, and recorded from East Africa. Now found in the Seychelles.

237. *Paralimnus silhouettensis*, sp. n. (Plate 51, fig. 18 *a*).

Head, pronotum, scutellum and tegmina, glossy bronzy-brown; scutellum with two pale spots on each lateral margin and a larger darker or blackish spot near each basal angle; tegmina with the veins darkly prominent and with more or less numerous pale greyish spots; body beneath and legs pale ochraceous; face longer than broad, its margins sinuate before eyes, between lateral margins of face and eyes the colour is darker with two small pale spots; vertex of head somewhat angularly produced in front of eyes, nearly twice as broad as long, ocelli on anterior margin very near eyes; scutellum broad, basal margin broader than length of either lateral margin, transversely impressed near middle; tegmina longer than abdomen, four apical cells, three ante-apical cells, a transverse vein on disk.

Long. incl. tegm. 6 to 7 mm.

Loc. Seychelles. Silhouette: from marshy plateau of Mare aux Cochons, about 1000 feet; forest above Mare aux Cochons.

EXPLANATION OF PLATES 49—51.

Plate 49.

Fig. 1. *Aselgeoides insularis*, gen. et sp. n. *a*, face and clypeus.
Fig. 2. *Ugyops facialis*, sp. n. *a*, face and clypeus.
Fig. 3. *Ugyops senescens*, var. *a*, face and clypeus.
Fig. 4. *Ugyops seychellensis*, sp. n. *a*, face and clypeus.
Fig. 5. *Daradaxoides mahensis*, gen. et sp. n. *a*, face and clypeus.
Fig. 6. *Privesa melanaria*, sp. n. *a*, face and clypeus.
Fig. 7. *Privesa fryeri*, sp. n. *a*, face and clypeus.
Fig. 8. *Neoprivesa fuscovaria*, gen. et sp. n. *a*, face and clypeus.
Fig. 9. *Caneirona maculipennis*, gen. et sp. n. *a*, face and clypeus.
Fig. 10. *Adolendana typica*, gen. et sp. n. *a*, face and clypeus.
Fig. 11. *Aquœlicium typicum*, gen. et sp. n. *a*, face and clypeus.
Fig. 12. *Curiatius insignis*, gen. et sp. n. *a*, face and clypeus.
Fig. 13. *Volcanalia typica*, gen. et sp. n. *a*, face and clypeus.
Fig. 14. *Brixia mahensis*, sp. n. *a*, face and clypeus.
Fig. 15. *Clusivius spectabilis*, gen. et sp. n. *a*, face and clypeus.
Fig. 16. *Matutinus opulentus*, gen. et sp. n. *a*, face and clypeus.
Fig. 17. *Brixia stellata*, sp. n. *a*, face and clypeus.

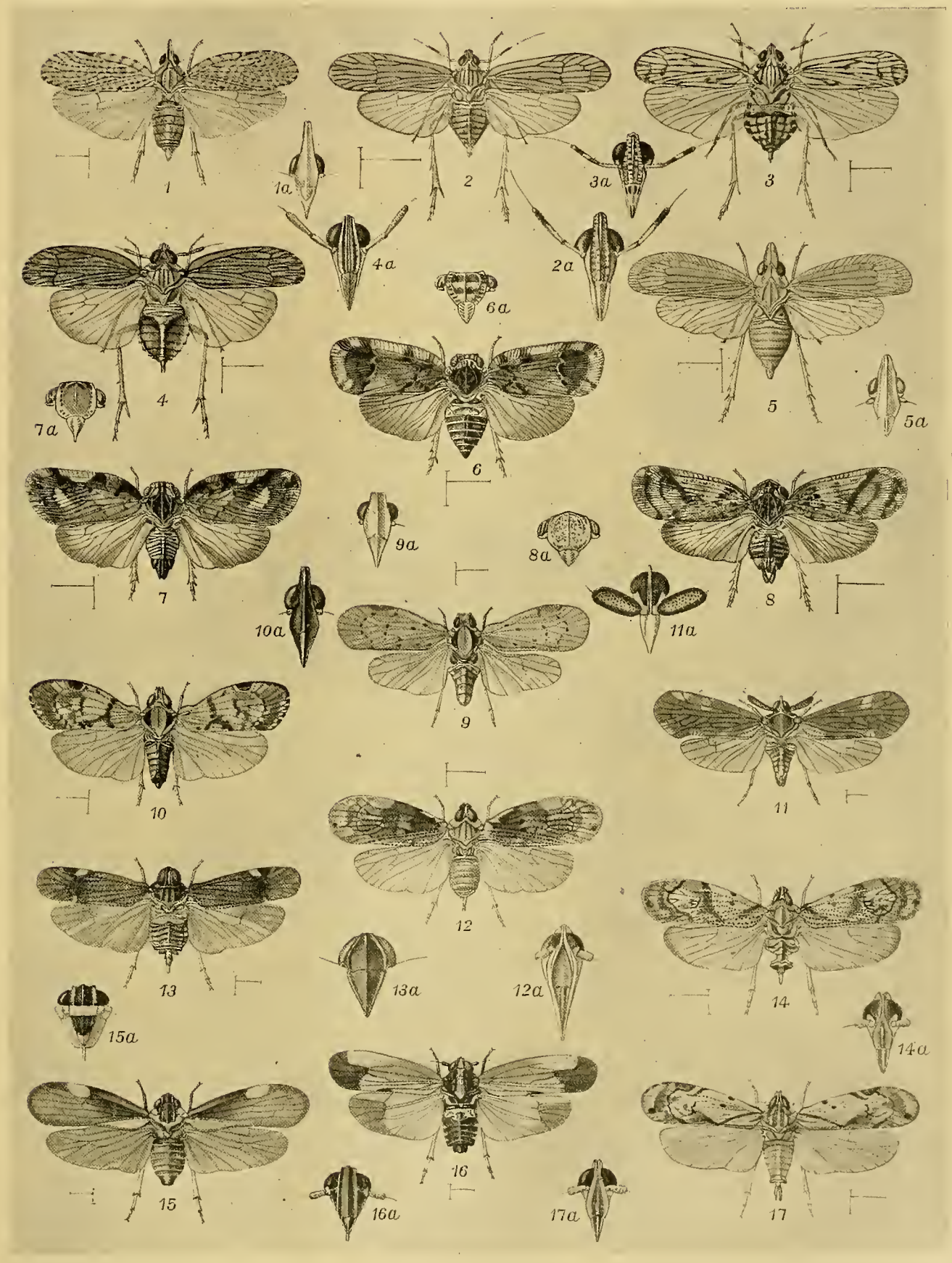
Plate 50.

Fig. 1. *Deferundata aldabrana*, gen. et sp. n. *a*, face and clypeus.
Fig. 2. *Ketumala rubromarginata*, sp. n. *a*, face and clypeus.
Fig. 3. *Armilustrium gardineri*, gen. et sp. n. *a*, face and clypeus.
Fig. 4. *Armilustrium scotti*, sp. n. *a*, face and clypeus.
Fig. 5. *Carmentalia biformis*, gen. et sp. n. *a*, face and clypeus.
Fig. 6. *Consualia robusta*, gen. et sp. n. *a*, face and clypeus.
Fig. 7. *Lollius atromaculatus*, sp. n. *a*, face and clypeus. *b*, side view and legs.
Fig. 8. *Lollius virescens*, sp. n. *a*, face and clypeus. *b*, side view and legs.
Fig. 9. *Flatoides protea*, sp. n. *a*, face and clypeus. *b*, side view of tegmen.
Fig. 10. *Opiconsiva fuscovaria*, gen. et sp. n. *a*, face and clypeus.
Fig. 11. *Opiconsiva colorata*, sp. n. *a*, face and clypeus.
Fig. 12. *Opiconsiva insularis*, sp. n. *a*, face and clypeus.
Fig. 13. *Opiconsiva derelicta*, sp. n. *a*, face and clypeus.
Fig. 14. *Opiconsiva modesta*, sp. n. *a*, face and clypeus.
Fig. 15. *Volcanalia modesta*, sp. n. *a*, face and clypeus.
Fig. 16. *Volcanalia varicolor*, sp. n. *a*, face and clypeus.
Fig. 17. *Volcanalia fumosa*, sp. n. *a*, face and clypeus.
Fig. 18. *Volcanalia atrovaria*, sp. n. *a*, face and clypeus.
Fig. 19. *Volcanalia picturata*, sp. n. *a*, face and clypeus.
Fig. 20. *Volcanalia cardui*, sp. n. *a*, face and clypeus.
Fig. 21. *Volcanalia atrostriata*, sp. n. *a*, face and clypeus.

Plate 51.

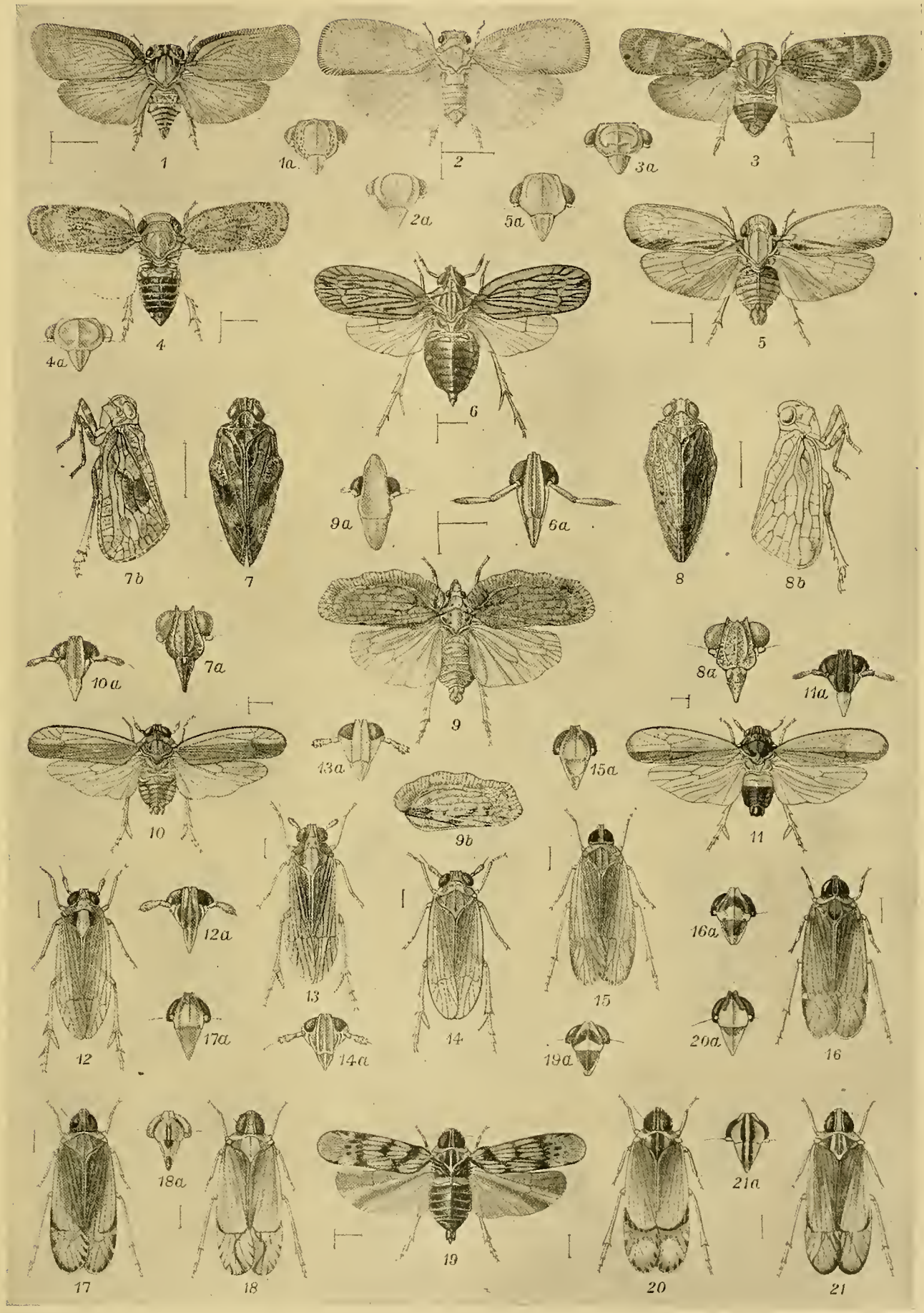
Fig. 1. *Ambarvalia pyrops*, gen. et sp. n. *a*, face and clypeus.
Fig. 2. *Volcanalia capitata*, sp. n. *a*, face and clypeus.
Fig. 3. *Nisia fuscofasciata*, sp. n. *a*, face and clypeus.
Fig. 4. *Nisia maculosa*, sp. n. *a*, face and clypeus.

Fig. 5. *Iguvium albomaculatum*, gen. et sp. n. *a*, face and clypeus.
Fig. 6. *Equirria phalœna*, gen. et sp. n. *a*, face and clypeus.
Fig. 7. *Aquœlicium brunnescens*, sp. n. *a*, face and clypeus.
Fig. 8. *Opiconsiva balteata*, sp. n. *a*, face and clypeus.
Fig. 9. *Aquœlicium elegantulum*, sp. n. *a*, face and clypeus.
Fig. 10. *Fescennia aurea*, sp. n. *a*, face and clypeus.
Fig. 11. *Fescennia bimaculata*, sp. n. *a*, face and clypeus.
Fig. 12. *Limentinus aldabranus*, sp. n. *a*, face and clypeus.
Fig. 13. *Jassus indicus*. *a*, face and clypeus.
Fig. 14. *Nilaparvata mahensis*, sp. n. *a*, face and clypeus.
Fig. 15. *Fordicidia robusta*, gen. et sp. n. *a*, face and clypeus.
Fig. 16. *Jassus determinatus*, sp. n. *a*, face and clypeus.
Fig. 17. *Acropona prasina*. *a*, face and clypeus.
Fig. 18. *Paralimnus silhouettensis*, sp. n. *a*, face and clypeus.
Fig. 19. *Acropona sladeni*, sp. n. *a*, face and clypeus.
Fig. 20. *Ujna flavidipes*, sp. n. *a*, face and clypeus.
Fig. 21. *Acropona gardineri*, sp. n. *a*, face and clypeus.
Fig. 22. *Nehela aterrima*, sp. n. *a*, face and clypeus.
Fig. 23. *Nehela flavolineata*, sp. n. *a*, face and clypeus.
Fig. 24. *Nehela elegantula*, sp. n. *a*, face and clypeus.
Fig. 25. *Nehela bimaculicollis*. *a*, face and clypeus.
Fig. 26. *Nehela conspicua*, sp. n. *a*, face and clypeus.
Fig. 27. *Nehela spectabilis*, sp. n. *a*, face and clypeus.
Fig. 28. *Nehela scutellata*, sp. n. *a*, face and clypeus.



H. Knight del

RHYNCHOTA FROM SEYCHELLES



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RHYNCHOTA FROM SEYCHELLES

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RHYNCHOTA FROM SEYCHELLES

No. VIII.—ON THE PONTONIINÆ.

By L. A. Borradaile, M.A.

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(Communicated by Prof. J. Stanley Gardiner, M.A., F.R.S., F.L.S.)

(Plates **52—57**.)

Read 2nd November, 1916.

FOREWORD.

The collections made during Professor Stanley Gardiner's two expeditions to the Western Indian Ocean are particularly rich in Pontoniinæ, and contain many new species, some of which are of peculiar interest. In view of these facts, and of the large additions to our knowledge of the group that have been made since my revision of it in 1898, I have thought well again to revise it as a whole*. The results of my labours are embodied in the present paper.

The following is a list of the species collected, with a statement of the localities in which they were taken:

1. *Urocaridella gracilis* Borradaile, 1915. Suvadiva, Kolumadulu, and Haddumati Atolls.
2. *Urocaris* sp., ? *U. longicaudata* Stimpson, 1860. N. Malé Atoll, Amirante.
3. *Urocaris psamathe* de Man, 1902. N. Malé Atoll, Diego Garcia.
4. *Palæmonella tridentata* Borradaile, 1899. Goidu, Goifurfchendu Atoll, S. Nilandu Atoll, Salomon, Coin, Peros Banhos.
5. *Palæmonella elegans* Borradaile, 1915. Salomon Is.
6. *Palæmonella longirostris* Borradaile, 1915. Reef, Naifaro, Fadiffolu Atoll.

* The present article was finished towards the end of the year 1914. Since then there have been described the following new species which probably or certainly belong to the Pontoniinæ.

(1) *Paratypton siebenrocki* Balss, 1915 (Zool. Anz. xlv. p. 83), Red Sea and Samoa. A remarkable coral commensal, superficially resembles *Conchodytes*. As neither the telson nor the gill formula are described it is not certain that this is a member of the Pontoniinæ.

(2) *Urocaris indica* Kemp, 1915 (Mem. Ind. Mus. v. p. 279), Chilka Lake, India. Perhaps accounts for Pearson's report of *U. longicaudata* from Ceylon. Lives in water whose salinity varies, and which is at times nearly fresh.

(3) *Periclimenes demani* Kemp, 1915 (*loc. cit.* p. 275). A member of the subgenus *Falciger*. From the same waters as *U. indica*.

(4) *Periclimenes* (*Hamiger*) *novæ-zealandiæ* Borradaile, 1916 (Brit. Antarct. ("Terra Nova") Exp. Rep., Zool., III, 2, p. 87, 1916), New Zealand. Representative of a new subgenus and possibly of a new genus. First chela has fingers fringed with long curled hairs, second pair unequal, one very large and of abnormal shape. Hepatic spine absent. Ischiomeropodite of third maxilliped somewhat broadened.

7. *Periclimenes* (*Cristiger*) *frater* Borradaile, 1915. Reef, Egmont.
8. *Periclimenes* (*Cristiger*) *incertus* Borradaile, 1915. S. Nilandu Atoll.
9. *Periclimenes* (*Cristiger*) *brocki* (de Man), 1887. Suvadiva Atoll.
10. *Periclimenes* (*Corniger*) *ceratophthalmus* Borradaile, 1915. Hulule, Malé Atoll.
11. *Periclimenes* (*Corniger*) *cornutus* Borradaile, 1915. Hulule, Malé Atoll.
12. *Periclimenes* (*Falciger*) *vitiensis* Borradaile, 1898. Coetivy, Seychelles.
13. *Periclimenes* (*Falciger*) *affinis* Borradaile, 1915. Salomon Is.
14. *Periclimenes* (*Falciger*) *dubius* Borradaile, 1915. Minikoi.
15. *Periclimenes* (*Falciger*) *nilandensis* Borradaile, 1915. S. Nilandu Atoll.
16. *Periclimenes* (*Falciger*) *seychellensis* Borradaile, 1915. Praslin, Seychelles.
17. *Periclimenes* (*Falciger*) *brocketti* Borradaile, 1915. N. Malé Atoll.
18. *Periclimenes* (*Falciger*) *suvadivensis* Borradaile, 1915. Suvadiva Atoll.
19. *Periclimenes* (*Falciger*) *borradailei* Rathbun, 1904 Haddumati Atoll.
20. *Periclimenes* (*Falciger*) *kolumadulensis* Borradaile, 1915. Kolumadulu Atoll.
21. *Periclimenes* (*Falciger*) *compressus* Borradaile, 1915. Saya de Malha, 145 fms.
22. *Periclimenes* (*Falciger*) *spiniferus* de Man, 1902. Goidu, Goifurfchendu Atoll, Hulule, Malé Atoll, Coetivy, Seychelles, Salomon Is., Diego Garcia.
23. *Periclimenæus fimbriatus* Borradaile, 1915. Mulaku Atoll, Providence, 39—50 fms.
24. *Periclimenæus robustus* Borradaile, 1915. Amirante, 29—39 fms.
25. *Harpiliopsis beaupresi* (Audoin), 1825. Goidu, Goifurfchendu Atoll, Hulule, Malé Atoll, Barachois, Diego Garcia.
26. *Harpiliopsis depressus* (Stimpson), 1860. Goidu, Goifurfchendu Atoll, Hulule, Malé Atoll. Reef, Naifaro, Fadiffolu Atoll. Minikoi. Coetivy, Seychelles. Coin, Peros Banhos. Salomon Is.
27. *Coralliocaris graminia* (Dana), 1852. Coetivy, Seychelles.
28. *Coralliocaris nudirostris* (Heller), 1862. Goifurfchendu Atoll, Coetivy, Seychelles.
29. *Coralliocaris macrophthalma* (H. M.-Edwards), 1837. Saya de Malha, 26 fms.
30. *Coralliocaris japonica* Ortmann, 1891. Hulule, Malé Atoll. Coin, Peros Banhos. Coetivy, Seychelles. Salomon Is. Saya de Malha, 26 fms.
31. *Anchistus miersi* (de Man), 1888. Hulule, Malé Atoll. Egmont, Seychelles.
32. *Pontonides maldivensis* (Borradaile), 1915. Fadiffolu Atoll.
33. *Conchodytes tridacnæ* Peters, 1851. Hulule, Malé Atoll. Minikoi.
34. *Conchodytes meleagrinæ* Peters, 1851. Salomon, Farquhar, N.W. Cheval.

Rather more than half the species in the above list were new, and among these are representatives of three genera previously unrecognized. I have established a fourth genus for two of the species that were already known to science.

It is unfortunately not at present possible to reach any faunistic conclusions concerning the Carides of the Western Indian Ocean.

My revision is not based solely upon the specimens placed in my hands by Professor Gardiner. By the kindness of Mr F. A. Potts I am enabled to include in

it the results of the examination of a small but interesting collection made by him in the Torres Straits, which contained three species new to science, one of them the representative of a new genus. I have also re-examined the material in the Cambridge University Museum of Zoology, and am under much obligation to Dr W. T. Calman for enabling me to do the same with the Pontoniinæ of the British Museum.

I have not restricted myself to the systematics of the subfamily. The unfortunate destruction in transit of a great part of the crustaceans collected by myself in the Island of Minikoi has deprived me of the numbered specimens to which my field notes applied, and thereby rendered it impossible for me to give information upon the natural history of various prawns, but I have endeavoured to elucidate to some extent the conditions under which Pontoniinæ live, and the connection between their structure and their habits. It has seemed to me advisable also to discuss briefly certain questions of morphology and genetics, and impossible to omit consideration of the relationship of the genera of Pontoniinæ with one another and with other prawns.

Short definitions of the new species and of three of the new genera have already appeared in the Annals and Magazine of Natural History for February, 1915. Fuller diagnoses, with notes on some other species, will be found in the course of the present article.

A Monograph of the Pontoniinæ.

It is one of the paradoxes of Marine Natural History that the Decapod Crustacea, the most active and nervous of the invertebrates of the sea, are also among the most prone to avail themselves of opportunities of shelter and concealment, and make use of the most subtle adaptations to this habit. In describing the collection of crabs made by Professor Gardiner and myself in the Maldive Islands and Minikoi*, I found occasion for some remarks upon this phenomenon with regard to the various groups of Brachyura. Among the prawns, two families are pre-eminent in the same respect. Professor Coutière's fine researches upon the Alpheidæ have illuminated one of these cases. The other is that of the Pontoniinæ. Although the members of this group have not so rich an originality as have the Alpheidæ in the production of bizarre modifications of structure, they are in one way even more interesting, for they show a more complete series of stages in the transformation of the primitive caridoid facies, ranging from wholly free-living forms such as *Urocaris* to commensal and very considerably degenerate genera such as *Conchodytes*. The success which has attended their strategy of retreat makes them so abundant that they bulk largely in any well-made collection of prawns from the Tropics, and their species are numerous and often closely related, though generally perfectly distinct. Moreover, the assembling of the species into genera and other groups is a matter of great difficulty, partly because they present an almost unbroken series of degrees of modification, associated, no doubt, with a gradually increasing dependence upon the host, and partly because among species of similar habits similar features reappear with bewildering frequency. They are therefore of as much importance to the systematist as to the naturalist.

* Gardiner's Fauna of the Maldives.

The Pontoniinæ are members of the Palæmonidæ, the central and typical family of the Carides. By the loss of exopodites and mastigobranchs from the legs, the reduction of the gill formula, and the position of the last joint of the second maxilliped at the side of the preceding joint, this family has discarded the primitive organization which still prevails in such groups as the Pasiphæoida and the Hoplophoroida. In the well-marked cleft of the mandible, the retention of the distal "lacinia" of the maxilla, the shape of the legs of the first two pairs, with their undivided carpopodites and relatively unspecialized chelæ, and in a certain absence of exaggeration in all the features of the body, they appear more conservative than the remaining members of the tribe, to some of which, indeed, and in particular to the Crangonoida, it seems possible that their near ancestors may have given rise.

The Subfamilies of the Palæmonidæ.

The members of the Palæmonidæ fall into four groups, which we may rank as subfamilies, defining them briefly by means of the following key:

I. None of the bristles at the end of the larval telson become in the adult transposed on to the anterior part of that organ, which is therefore unarmed on its back and sides. The surface of the molar process of the mandible is closely ridged. [There is a pleurobranch on the third maxilliped.]

Desmocaridinæ Borradaile, 1915.

II. Two pairs of the bristles at the end of the larval telson become in the adult transposed on to the back of that organ. The surface of the molar process of the mandible bears some half-dozen large knobs or crests.

A. The end of the telson bears six spines. [There is no pleurobranch to the third maxilliped.]

Pontoniinæ Kingsley, 1878.

B. The end of the telson bears four spines and a varying number of feathered bristles.

1. The side of the carapace is traversed by a suture. The outer flagellum of the antennule is but slightly cleft. There is no pleurobranch to the third maxilliped.

Typhlocaridinæ Annandale and Kemp, 1913.

2. The side of the carapace has no suture. The outer flagellum of the antennule is deeply cleft. There is a pleurobranch to the third maxilliped.

Palæmoninæ Kingsley, 1878.

The peculiarities set forth in this key belong to all members of the subfamilies, which by their means can be absolutely separated. In elucidating the relations of the subfamilies to one another, however, account must also be taken of certain universal characteristics by which the affinities of the groups are indicated.

Of the four subfamilies, that of the Desmocaridinæ is the most primitive, as has been well shown by M. Sollaud, the describer of its only genus, *Desmocaris**. Among

* C. R. Ac. Sci. clii. p. 913 (1911).

other features, M. Sollaud finds the following to indicate its nearness to the ancestral form of the family: (1) the condition of the telson, (2) the retention of the larval supraorbital spine, (3) the armature of the molar process*, which recalls that of the primitive *Acanthephhyra* (Hoplophoridæ), (4) the simple form of the epipodite of the first maxilliped, which in most other Palæmonidæ is bilobed, (5) the relation of the propodite of the second maxilliped to the dactylopodite, which is here largely free, instead of lying wholly alongside the propodite, (6) the armature of the fingers of the chelæ, which consists of fine spines arranged comb-wise, as in many Hoplophoridæ and Penæidæ, and not of a cutting edge or coarse teeth, as in most Carides, (7) the gill-formula, which comprises a pleurobranch for each leg and one for the third maxilliped, one arthrobranch for the latter limb, and a podobranch on the second maxilliped. At the same time, *Desmocaris* is not without features which constitute a departure from the primitive state. As such may be cited (8) the loss of the mandibular palp, (9) the disappearance of the cleft between the two divisions of the outer "lacinia" of the maxilla, and (10) great reduction of the podobranch of the second maxilla.

The Palæmoninæ are less primitive than *Desmocaris* in respect of the characters numbered (1), (2), (3), (5), and (6) above, and most of them have a bilobed epipodite on the first maxilliped, though in regard to (9), (10), and generally also to (8), they are more primitive. The Typhlocaridinæ are an aberrant branch of the Palæmonine stock.

On the other hand, the less specialized of the Pontoniinæ are in many respects near to the ancestral type. It is true that in the condition of the telson and of the molar process†, and in the loss of the pleurobranch of the third maxilliped, all Pontoniinæ are unprimitive, but (*a*) many keep the supraorbital spine, (*b*) while nearly all have lost the mandibular palp, *Urocaridella* and *Palæmonella* keep this structure, though it is here of two joints, and not of three as in the Palæmoninæ, (*c*) nearly all have a double lacinia on the maxilla, (*d*) some have a simple epipodite to the first maxilliped, and in many cases it is but slightly cleft, (*e*) some (belonging it is true to the more modified genera *Harpilius* and *Coralliocaris*) have a free, or nearly free, dactylopodite of the second maxilliped, (*f*) though the anterior pleurobranch is lost, *Urocaridella*, and according to Nobili some *Ancyclocaris*, have a podobranch on the second maxilliped, and (*g*) several species of *Periclimenes* have the comb arrangement on the fingers of the first chela, and in at least one (*P. denticulata*) it is found also on the second. Moreover (*h*) in the form of the outer flagellum of the antennule, which is generally but slightly cleft, the Pontoniinæ present a primitive feature not found in either *Desmocaris* or the Palæmoninæ. Since, however, this feature is in the present subfamily found in the genera which are otherwise not primitive, it seems likely that it is here not ancestral but a reversion.

It would appear therefore that, though *Desmocaris* has departed least from the structure of the ancestral palæmonid, the Pontoniinæ left the main stem before the evolution of the first representative of the Palæmoninæ.

* The molar surface is a plain, round area, about half of which is covered by toothed ridges. These are probably an exceedingly primitive feature, for they are found in many Branchiopoda.

† But see below, p. 335.

Desmocaris and the Palæmoninæ are active, free-living prawns, mostly inhabiting fresh or brackish water. The Pontoniinæ, on the other hand, are marine, and most of them lead a hidden and sluggish life, depending for shelter upon other animals, such as corals, bivalves, echinoderms, and ascidians. Are we to consider that the non-primitive characters which differentiate this group have any connection with their mode of life? Clearly, since not all Pontoniinæ lead a sluggish existence, it is not possible to regard the diagnostic characters of the subfamily as direct adaptations to such existence. In any case it would be hard to see this significance in the armature of the telson, or in the structure of the mandible, which is no doubt connected with some peculiarity, either in the food or in the mode of feeding, shared by the Palæmoninæ. It is, indeed, somewhat remarkable to find that the mandible of the most advanced commensals of the subfamily does not differ essentially from those of its most primitive members. But M. Sollaud is quite possibly right in considering* that the reduction of the gill series, though it cannot have been caused by the change to a less active life, has tended to bring about such a change. If, however, the characters of the Pontoniinæ as a whole cannot be regarded as direct adaptations to a sheltered life, there is within the group a long series of such modifications, exhibited by almost every organ of the body, and often traceable from genus to genus in a striking manner.

The History of the Pontoniinæ.

The subfamily Pontoniinæ comprises fifteen genera, described at various dates from 1829 to the present day. The first of these to be established was *Pontonia*, founded by Latreille in 1829†, for a species, commensal with bivalves, which had been named by Petagna *Astacus tyrrhenus* (Plate **57**, fig. 29). By 1837, when H. Milne-Edwards published his *Histoire Naturelle des Crustacés*, the number of species assigned to this genus had risen to four. Roux in 1831 gave the name *Pelias* to two prawns of more active habit which are now known as *Periclimenes scriptus* and *P. amethysteus*, *Pelias* being preoccupied as a generic name. *Periclimenes* was given its present name in 1844, by Costa, who at the same time founded *Typton* for a species living in sponges. In 1851, Peters established *Conchodytes* for two very specialized species related to *Pontonia*. Hitherto isolated genera had been founded, but in 1852 the first steps were taken towards recognizing the unity of a group of forms which was to become the nucleus of the present subfamily. In that year Dana, reporting on the Crustacea of the United States exploring expedition, separated from *Pontonia* certain coral-haunting species which he erected into the genera *Oedipus* and *Harpilius*. *Conchodytes* he did not recognize. At the same time he described as allied to these a genus *Anchistia*, which has subsequently proved to be the same as Costa's *Periclimenes*, and indicated in a footnote that the true position of *Typton* was in this neighbourhood. The name *Oedipus* was already in use, and Stimpson accordingly changed it in 1860 to *Coralliocaris*. *Palæmonella*, also founded by Dana, was placed by him between *Anchistia* and *Palæmon*, and Stimpson, in founding *Urocaris*, placed

* C. R. cli. p. 1158. † References will be found below.

it between *Anchistia* and *Palæmonella*. Both *Palæmonella* and *Urocaris* consist of gracefully built species, and until recently it has generally been considered that their affinities are Palæmonine rather than Pontoniine. In 1878 Kingsley founded a subfamily Pontoninæ for the genera *Pontonia*, *Coralliocaris*, *Harpilius*, *Anchistia*, *Urocaris*, and *Typton*, together with the *Euryrhynchus* of Miers and *Palæmonetes* of Heller which are certainly Palæmoninæ and have been treated as such by all subsequent authors. In 1879, however, Kingsley treated the members of the Pontoninæ merely as a section of his Palæmoninæ. In 1888 Bate raised them to the rank of a family—the Pontoniidæ. In 1890 Ortmann made considerable contributions to our knowledge of this family, and in 1899 he added to it the Hymenocerinæ, placing its original members in a subfamily Pontoniinæ. The true affinities of *Hymenocera*, however, are not represented by this arrangement*. In 1898 I revised the Pontoniidæ, establishing a new genus *Anchistus* for some species intermediate between *Periclimenes* and *Pontonia*. Since then Nobili has founded in 1902 the genus *Coutierea*, and in 1906 *Stegopontonia*, both related to *Coralliocaris*. *Ancyclocaris*, established in 1902 by Schenkel for a prawn which is now known to shelter under the protection of a sea anemone, was connected with the Pontoniidæ by Nobili in 1906. In 1907 I reverted to the view that the Pontoniinæ should rank as a subfamily of the Palæmonidæ. Finally, Sollaud, in an illuminating article (1910), discussed the characteristic features of the Pontoniidæ, and definitively included among them the genera *Palæmonella* and *Urocaris*. In the present paper five new genera—*Urocaridella*†, *Pontoniopsis*†, *Periclimenæus*†, *Pontonides*, and *Harpiliopsis*—are proposed, and four subgenera established within the genus *Periclimenes*‡.

The history of the Pontoniinæ as a unit of classification may be summed up as follows:

Subfamily **Pontoniinæ** Kingsley, 1878.

Pontoninæ Kingsley, Bull. Essex Institute, x. p. 53 (1878).

Pontoniidæ Bate, "Challenger" Macrura, p. 927 (1888). Ortmann, in Spengel, Zool. Jahrb. Syst. v. p. 460 (1890). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 376 (1898). Rathbun, Bull. U. S. Fish. Comm. xx. II. p. 120 (1901). Sollaud, C. R. Ac. Sci., cli. p. 1158 (1910).

Pontoniinæ Ortmann, Bronn's Thierreich, v. II. pp. 1124, 1130 (1899). Borradaile, Ann. Mag. Nat. Hist. (7), xix. p. 472 (1907); Ib. (8) xv. p. 206 (1915).

The Organization of the Pontoniinæ.

The connection between structure and mode of life is very clearly shown by the *habit of body* of Pontoniinæ. In *Urocaridella* (Plate **53**, fig. 2) and *Urocaris*, whose members are probably all free swimmers, the body is slender and strongly compressed, with a very long sixth abdominal segment. In *Palæmonella* (Plate **53**, fig. 5) and *Periclimenes* (Plate **52**, fig. 1), which wander, with an activity that probably varies from species to species, over

* See pp. 405, 408, 410 in this volume.

† Preliminary descriptions of these genera have been published in the Annals and Magazine of Natural History for February, 1915.

‡ *Marygrande* Pesta, 1911, is not, in my opinion, distinct from *Anchistus*.

the surface of various objects on the sea-floor, or shelter without quiescence upon the bodies of echinoderms, where they have neither a stable foothold nor great protection, the habit of body is very much that of the *Leander* of the British coast—slender, but without the attenuation of *Urocaris*. *Periclimenes* (Plates **54**, **55**, figs. 10—16) shows considerable variety in body form, and this is no doubt connected with differences in habitat and activity. *Periclimenæus* (Plate **55**, figs. 19, 20) is an aberrant group of *Periclimenes* which has taken on an *Alpheus*-like habit of body, no doubt in accordance with some special mode of life. *Pontoniopsis*, commensal with a crinoid, is more modified in respect of some of its organs than is *Periclimenes*, but in regard to habit of body is in much the same condition. *Ancyclocaris*, living within the zone of protection of a large sea-anemone, whose mouth it even enters at times, has a more stoutly built body with, in the female, a hump on the back of the thorax which suggests some peculiarity in the ovary. *Harpiliopsis*. *Harpilius*, and *Coralliocaris* are adapted by their heavy, depressed bodies to a sluggish life among the branches of coral stocks, in that habitat which swarms with *Trapezia* and other small crabs, and is such a rich collecting ground for the marine zoologist in the tropics. *Stegopontonia* is an aberrant member of this group of genera, adapted for an existence spent among the spines of a sea-urchin, and *Coutierea*, also related here, bears, with its spiny, keeled abdomen, and long rostrum and supraorbital spines, the characteristic appearance of a deep sea crustacean. *Anchistus*, *Pontonia* and *Conchodytes*, which live within the shells and tests of bivalves and ascidians, have reached the highest degree of specialization in the subfamily. Their swollen, clumsy bodies, though not more depressed than those of *Coralliocaris* and *Harpiliopsis*, have in some cases almost lost the semblance of prawns, and suggest degeneration as strongly as that of the crab *Hapalocarcinus*, to which they bear no little resemblance. *Typton*, though heavily built, is compressed and prawn-like, and is no doubt adapted by its shape to life in the canal system of the sponges which it inhabits. In all these cases, the male, though his body tends to undergo the same modifications as that of his mate, has a more normal appearance than she, principally because his abdomen is less enlarged (Plate **57**, fig. 29).

Thoracic sterna are distinct and well formed in all genera of the subfamily, though narrow between the maxillipeds, and there is not in this respect the difference that might be expected between *Periclimenes* and the more stoutly built forms. In *Urocaridella* and *Urocaris*, the sterna are narrow, in correspondence with the compression of the body.

The *abdomen* of the Pontoniinæ is of the caridean type, with a fairly large first segment, a very large second segment, and a bend between the third and fourth segments. This bend is most marked in *Urocaridella* and *Urocaris*, but it is distinct in all other genera except *Pontonia*, *Pontonides*, and *Conchodytes*, where it is merged into a general curvature of the hinder segments. In the more sedentary genera the pleura of the first three segments of the female are very large and foliaceous, and form, with the incurved tail fan, a great pocket for the eggs. In *Urocaridella* and some species of *Urocaris* the hinder part of the third tergum is swollen into a hump, and bears a hooked process which overhangs the succeeding segment.

Like other prawns, the Pontoniinæ have an *armature of spines* on prominent parts of the body. The use of this armature is realised at once when a prawn is held alive in the hand. With its abdomen bent under the thorax, the animal is a wedge-shaped object with the broad end in the direction of escape—that is backwards—and all its spines projecting forwards, so that they preserve for it any ground which it gains in its struggles. The armature includes the rostrum and its teeth, spines on the carapace, on the two pairs of antennae, and often on the uropods, and in a few cases a hooked projection at the back of the third abdominal segment. As might be expected, it is less developed in the heavily built sedentary forms than in the lighter species which live a more exposed life.

The *rostrum* is probably seen in its earliest form in some of the species of *Periclimenes*. Typically, in this genus it is a straight, compressed, lanceolate structure (Plate **54**, fig. 10 *a*), of about the same length as the region of the carapace behind it, and bears above and below a fairly deep, toothed crest, the upper crest being continued upon the carapace by a row of two or three teeth. This form of rostrum is well seen in *P. scriptus*. In certain cases it loses some or all the teeth of the ventral crest (Plate **54**, fig. 9 *a*) or even the crest itself. Sometimes, as in *P. brevinaris*, it becomes shorter. In other species, as in *P. ensifrons*, it is curved upward at the end, so that the upper edge becomes concave. Often, as in *P. spiniferus* (Plate **52**, fig. 1 *a*), the curved rostrum is longer and slenderer than the lanceolate type, and this tendency reaches its height in *P. borradailei* and *P. kolumaduluensis*. *Urocaridella* (Plate **53**, fig. 2 *a*) has a very long and much upcurved rostrum, toothed above and below, with the dorsal crest high at the base. *Urocaris* loses the ventral teeth of this rostrum, and in some species has the organ shortened by the loss of the slender distal part. *Palæmonella* has a shallow rostrum, usually rather short and nearly straight. In *Ancyclocaris* it is short and straight, but of a good depth. The more sedentary genera show varying degrees of reduction and modification of this rostrum. The reduction is least marked in *Harpiliopsis*, *Harpilius*, and *Coralliocaris*. In *Harpiliopsis* and *Harpilius* the rostrum hardly differs from that of *Periclimenes*, but is rather small, and wide at the base. In *Coralliocaris* it is wide and shallow and the teeth show signs of reduction, though they are usually present, at least on the upper side. The free end is pointed both in dorsal and in side view, and is not curved downwards. In *Anchistus*, *Pontonia* (Plate **57**, fig. 29), and *Conchodytes*, on the other hand, the rostrum, though it is more or less depressed at the base, is (except in some species of *Pontonia*) deep and strongly compressed in the distal part. The tip is bent downwards, and in side view rounded or diminished abruptly to a point. Teeth are generally absent, but in some species of *Anchistus* there are small dentations near the tip. In *Typton* the rostrum is peculiar, being small, compressed, almost or quite toothless, and bent upwards at the free end, which is pointed. *Stegopontonia* and *Pontoniopsis* (Plate **57**, fig. 27), *Pontonides* (Plate **57**, fig. 28), and some species of *Pontonia*, differ from all other Pontoniinæ in having a broad and very shallow rostrum, lanceolate or triangular as seen from above.

Of the *spines of the carapace* the most persistent is the antennal, which is never entirely lost, though in some species of *Conchodytes* it becomes very blunt. The

hepatic spine is generally present in free-living species but it may be absent even here. It is found in *Harpiliopsis* but not in most species of *Harpilius* and *Coralliocaris*, or in the still more sedentary genera. The supraorbital spine is kept only by some *Periclimenes* (Plate **52**, fig. 1), *Coralliocaris rhodope*, *Typton* and *Coutierea*. In the latter two cases it is very large. True branchiostegal spines are never found. There is a pterygostomian spine in *Coutierea*. The lower angle of the orbit may be produced, but is generally blunt.

Here may be mentioned the *grooves of the carapace*. These are not well marked but very persistent. Groove *b* of Boas* is always present and there is usually some trace of *e*, though the latter never crosses the back.

The *telson* corresponds in width with the stoutness of the body, but always narrows towards its hinder end, which is triangular, with sometimes, in primitive forms, a pointed projection in the middle (Plate **52**, fig. 1 *p*). On the dorsum of the telson are two pairs of stout moveable spines. On each side of its hinder end are three spines, of which the outer is short and stout, and the intermediate long and strong. The sub-median is usually shorter than the intermediate and longer than the outer. It is also more slender, and in primitive forms often feathered (Plate **53**, fig. 2 *p*), showing thus a transition to the feathered bristles of other Palæmonidæ. In *Conchodytes*, *Pontonia*, and some *Anchistus*, however, the sub-median and intermediate spines are nearly equal, and in such cases they are usually of a clumsy, degenerate shape. The end of the telson also often bears two or three pairs of fine, unfeathered bristles, whose presence bears no relation to the degree of degeneracy of the species.

The *eyes* are set widely apart on a region immediately below the rostrum. Between them is a low swelling on which is seen the remains of the larval median eye (Plate **52**, fig. 1 *c*). Each eye-stalk starts with a narrow flexible region and suddenly expands into a wide region with stouter walls. This region is usually a little flattened, and at its end bears the cornea, which generally swells out beyond it at the sides. Such an eye is well seen in *Periclimenes* (Plate **52**, fig. 1 *b*) and the other little-modified genera, and also in *Harpiliopsis*, *Harpilius*, and *Coralliocaris*. In *Anchistus*, *Pontonia*, and *Conchodytes*, however, the eye, as might be expected, is smaller. It is also here more cylindrical, and the cornea is either of equal width with the stalk or even narrower. The eye of *Pontonides* (Plate **57**, fig. 28 *b*), in spite of the general resemblance of this prawn to *Pontonia*, is well developed and of the *Periclimenes* type. In *Ancyclocaris*, on the other hand, though the build of the body is *Harpilius*-like, the eye resembles that of *Pontonia*. Several interesting peculiarities are found. In *Periclimenæus* (Plate **55**, fig. 20 *a*) the moderately large cornea has a curious cup-shaped depression on the outer and lower side. In *Pontoniopsis* (Plate **57**, fig. 27 *b*) the eye is large and sub-globular, the cornea occupying one-half of the sphere. In the sub-genus *Corniger*, of *Periclimenes*, the cornea is ogival, and in *P.* (*C.*) *ceratophthalmus* (Plate **54**, fig. 9 *b*) this peculiarity culminates in the appearance of a papilla, such as is found in *Phyllognathia* and in the amphibious *Ocypode ceratophthalmus*. It would be interesting to determine the physiological result of the structure which thus recurs in genera

* K. Danske Vidensk. Selsk. Skrifter (6), ii. II. p. 25 (1880).

which are so widely separated, and differ even in respect of the medium through which light reaches the eye.

Genera with depressed bodies have the carapace hollowed behind the eye to give room for it to be turned backwards. In *Coralliocaris* this depression becomes a sharply-marked pit. There is here a striking repetition of the condition which in the crabs may be traced through further stages till it ends in the formation of a closed orbit.

In the *antennules* (Plate **52**, fig. 1 *c*), the basal joint bears on its outer side a thin flange which, generally speaking, varies in width with the body. At the base of this flange, on the outer side, stands the stylocerite, a forwardly-curved, strong spine, which is usually less than half the length of the joint, but sometimes, as in *Harpiliopsis* and *Coralliocaris*, becomes more important. At or near its end the flange bears another spine, smaller than the stylocerite. In *Urocaridella* and *Urocaris* the flange has a rounded, fringed tip, projecting beyond the end of the joint, with the distal spine at its side, so that the whole structure recalls the antennal scale. In *Palæmonella* and *Periclimenes* the end of the flange, slightly concave or convex, and usually fringed, is nearly on a level with the end of the joint, and bears its spine at its outer angle. In some species of *Periclimenes* (*P. frater*, etc., Plate **53**, fig. 6 *c*) there are two spines. In the heavier genera there is an unfringed projection forwards which bears the spine at its tip. In some species of *Conchodytes* this projection is blunt, the spine having disappeared. A well-developed statocyst is always present, which is not the case in all Carides. The second and third joints of the stalk vary a good deal in form. Typically they are sub-cylindrical and about as long as broad.

The inner flagellum is simple. The outer is more complex and shows variations of some importance. It is always thickened at the base, and bears in the thickened region a fringe of coarse, sensory hairs. At the end of this region, in all genera except *Typton*, a cleft separates a long, slender flagellum from a short, thick one, which is a continuation of the thickened region. The depth of the cleft varies. Usually it is less than the length of the uncleft basal region. In most *Periclimenes* (Plate **52**, fig. 1 *c*), some *Palæmonellæ*, and the heavier genera, it is a good deal less. In some *Periclimenes* (as *P. compressus*, Plate **55**, fig. 18), some *Palæmonellæ* (as *P. batei*), and in *Urocaris*, it is nearly or quite as long. In *Urocaridella* (Plate **53**, fig. 2 *a*) and *Ancyclocaris* it is longer than the basal region, and the antennule is then said to be "triflagellate." This is the condition found in other Palæmonidæ. Since the genera of Pontoniinæ which exhibit it are in other respects more primitive than the rest of the subfamily, it would appear to be in their case an ancestral feature, though of course the appearance of the third flagellum is in itself an innovation, and is one of the non-primitive features of the Palæmonidæ. The shortening of the cleft in higher Pontoniinæ is thus a return to primitive conditions, not a retained primitive feature. It is comprehensible that the lessened activity of these members of the subfamily should remove the necessity for a very mobile sensory apparatus.

The *antenna* (Plate **52**, figs. 1 *c* and *c'*) is of the normal caridean type. On the first joint (coxocerite) the tubercle for the opening of the green gland takes the form of a well-developed process on the inner side. The second joint (basicerite) is divided

longitudinally into two parts*—an inner, which bears the flagellum and its stalk (together forming the endocerite), and an outer, which bears the exocerite in the form of the scale (scaphocerite). On this outer division stands also a forwardly-directed spine, which may, as in *Harpiliopsis*, be very long and strong, or may be represented merely by a slight projection of the joint. As this spine is not homologous with the stylocerite of the antennule, standing indeed on a different joint, the same name should not be applied to it. The scale has a broad, fringed expansion and a stout, unfringed outer border, which ends in a distal spine. Its most remarkable variation is found in *Typton*, where it is reduced to a vestige, which does not reach as far as the beginning of the flagellum, though it shows traces both of the expanded region and of the distal spine. In the endocerite, the flagellum stands on a two-jointed stalk. It is doubtful whether there is any justification for calling the joints of this stalk "ischiocerite" and "merocerite." The flagellum, like those of the antennule, is shorter in the sedentary than in the active forms. It is shortest in *Conchodytes tridacnæ* and *C. meleagrinæ*.

The *mouth parts* show, on the whole, an absence of modification, either within the subfamily or in comparison with those of related groups, which is rather striking in view of the specialized nature of the food of many of the commensal forms—such, for instance, as those which live with crinoids or lamellibranchs—consisting as this must largely of minute organisms collected by the feeding currents of the host. The most remarkable features exhibited by the organs in question are (1) the tendency which appears in various genera to a broadening of some or all the joints of the third maxilliped, (2) in the *Pontonia* group, that the inner lacinia of the maxillule is very wide and hairy. The connection of these features with the functions of the organs is discussed below.

The *mandible* (Plate **52**, fig. 1 and Plate **57**, figs. 26 *d*—*d*‴) is deeply cleft into two diverging processes, both directed obliquely towards the median plane of the body. One of these—the *incisor process*—is thin and ribbon-like, trending at its base downwards, but curving inwards and at the same time twisting its outer edge forward, so that, while at its base it is nearly vertical, with its width transverse to the body, at its free end it is

* [June, 1917. These parts, of which the outer stands always a little forward of the inner, and in some Decapoda, as *Upogebia*, becomes almost wholly distal to it, probably represent the two components (protobasipodite and metabasipodite) of the basipodite (symbasipodite). I have recently discussed the composition of this segment (Proc. Zool. Soc. London, 1917, p. 53). The homologies of the antenna present a very difficult problem. It would appear from the case of the Mysidacea that the segment upon which the green gland opens is the second of the primitive series, and in that case the first, or precoxa, must in other cases have disappeared, by excalation or by fusion with the head or with the coxopodite. This suggestion is supported by the fact that the maxillary gland of Stomatopoda also opens upon the second segment of the limb to which it is adjacent (Proc. Zool. Soc. *loc. cit.*), and that the gonoducts of the Decapoda, probably homologous with the ducts of the excretory glands, open upon what development shows to be the second segment of the legs (except where, as in the crabs, the openings have secondarily shifted to the sterna). If Hansen be right in interpreting as segments the inconspicuous structures which undoubtedly exist in the antenna of *Nebalia* proximal to the first apparent segment and between those which appear to be the second and third, then there is in that genus a very complete and instructive retention of the primitive segmentation of the limb. The segments will be, in succession, precoxa (pleurocerite), coxocerite, protobasicerite, metabasicerite, and the so-called ischiocerite and merocerite incompletely fused. If, on the other hand, Hansen's view be not accepted, then the absence of exopodite and of visible opening of the green gland leaves the homologies of the segments obscure, though the flexion of the limb suggests that the incompletely double third joint belongs to the endocerite proper.]

nearly horizontal, with its width longitudinal in the body. The other—the *molar process*—is stout and subrectangular in section, and slants dorsally, to end obliquely truncated on the median plane. In *Urocaridella* (Plate **53**, fig. 2 d^{iv}) and *Palæmonella* (Plate **53**, fig. 5 d^{v}), a short, two-jointed palp is present, standing on the anterior side of the limb, at the base of, and just dorsal to, the incisor process, behind which it is partly hidden in ventral view. The incisor and molar processes perhaps represent the first two endites of the primitive crustacean appendage*. The palp represents the rest of the protopodite and the endopodite. Its first joint is probably the basipodite, but, in view of the facts of meristic variation, it is doubtful whether there would be any validity in such a statement as that the second is the ischiopodite. Still less can the third joint be regarded as the meropodite alone.

The incisor process usually ends in three teeth, the middle one of which is shorter than the others, but the intermediate teeth may be more numerous and sometimes differ in number on the two sides. Thus *Coralliocaris japonica* has two on one side and three on the other, while in *Conchodytes meleagrinæ* (Plate **57**, fig. 26 *d*) there are three and four, nearly equal to the outer teeth. The molar process ends in a roughly square, concave surface, surrounded by an incomplete wall made up of projecting lobes, from four to five in number. All but one of these have crescentic or horseshoe-shaped rims, open towards the middle. The remaining lobe has an unbroken rim, and a great part of its circumference is beset with a fur of bristles or a rough patch of tubercles. Opposite this lobe the wall is lower than elsewhere, and in the left mandible is also roughened. This roughening of the molar surface is, I think, the last remains of the clothing of bristles described for the Alpheidæ by Coutière†, who also figures in some cases an oval isolated area on one side of the process. The ridges which in *Amphibetæus* and some Hippolytidæ represent a part of the bristly surface may perhaps be transitional between this condition and that found in *Desmocaris* (p. 327). There are only very slight traces of a roughened surface in *Leander*, so that possibly the possession of a considerable extent of such a surface should be added to the list of primitive characters of the Pontoniinæ which are not found in Palæmoninæ. The lobes differ a good deal in shape, and there is only a general correspondence between those of the mandibles of the two sides. So far as this correspondence goes, it is not the mirror-likeness usually found in paired structures, but the two arrangements are reversed, so that the rough lobe of each molar process overhangs the lowest part of the edge of the other and the surfaces interlock.

The mandibles lie in a chamber enclosed between the *lips* (Plate **57**, figs. 26 *s* and *t*), the hood-like upper lip (labrum) standing in front of them and the large, bilobed lower lip (metastoma, Plate **52**, fig. 1 *q*) behind, while the swollen bases of the mandibles themselves close in the chamber at the sides. There are two openings to the lip chamber—a narrow median slit between the lobes (paragnatha) of the lower lip, and a wider transverse gap between the upper and lower lips. The incisor processes close the

* On the other hand, the incisor process may be merely an outgrowth from the molar process (gnathobase). An interesting analogue to it is seen in the flange at the end of the grinding surface of the mandible of *Apus*. As it stands, this flange is on the hinder side of the limb, but the shape of the mandible gives reason to suppose that it has been rotated backwards.

† Ann. Sci. Nat. Zool. (8), ix. pp. 152—157 (1899).

transverse opening, meeting in the middle line. The molar processes meet deeper in the chamber, just under the opening of the gullet.

In describing the maxillules and maxillæ, account must be taken of the fact that there is no agreement among authorities either as to the names to be applied to the leaf-like processes, usually known as *laciniæ*, which are borne on these limbs, or as to the joints which these processes represent. I shall assume the correctness of the following view. The maxillules and maxillæ of adult Decapoda can be derived from a type provided with five endites and a distal region which probably represents several further segments. Of these endites, the first stands in the region which represents the precoxal joint, the second proceeds from the region of the coxopodite, the third and fourth from that of the basipodite, and the fifth from that of the ischiopodite. The distal region forms the remainder of the endopodite. The laciniæ of the maxillule represent the first and third endites. I shall call them the *inner* and *outer laciniæ*. The two cleft lobes usually known as the "laciniæ" of the maxilla represent each two endites. I shall call them the *first* and *second lobes*. The first represents the endites of the precoxa and coxopodite, the second those of the basipodite. Boas* and Coutière† have shown that the endite of the ischiopodite is present in the larva, and in the adult is represented by a slight swelling often found at the base of the endopodite. The laciniæ of the first maxilliped represent the coxopodite and basipodite (two fused).

In the *maxillule* (*e* in figs.) the inner lacinia curves towards the outer. It is of varying width, widest in *Conchodytes* (Plate **57**, fig. 26*e*) and *Pontonia*, wide also in *Anchistus* (Plate **56**, fig. 25*e*), moderate in *Periclimenes* (Plate **52**, fig. 1*e*), narrow in *Harpiliopsis* (Plate **56**, fig. 22*e*) and *Urocaris* (Plate **53**, fig. 3*e*). It bears a varying number of bristles, of which a bunch at the end are stouter than the rest except in *Conchodytes*. The outer lacinia also varies in width. It has an edge directed towards the middle line of the body and bears along this edge a number of stout spines and usually also some that are more slender. In *Anchistus*, *Pontonia*, and *Conchodytes* both laciniæ are very hairy. The endopodite is bifid at the tip, the proximal branch, which possibly represents the fifth endite, being curved in a short spiral, the distal branch nearly straight. The latter is reduced to a faint lobe in *Harpiliopsis* (Plate **56**, fig. 22*e*), *Anchistus* (*Ib.* fig. 25*e*), *Pontonia*, and *Conchodytes* (Plate **57**, fig. 26*e*). The maxillules stand close against the paragnatha, the laciniæ of each opposed to those of the other across the middle line, but not quite meeting them. The inner laciniæ are behind the cleft of the metastoma, with a low median ridge between them; the outer stand beside the cleft. The endopodite (endognathite) is directed outwards and appears to give a purchase to the action of the limb by hooking its curved process around the outer edge of the lip, which is provided with a notch to receive it.

In the *maxilla* (*f* in figs.) the first double lobe has disappeared, and is represented only by a slight swelling of the edge of the limb, on which a faint notch sometimes still indicates its double nature. The second lobe is of a good length,

* K. Danske Vidensk. Selsk. Skr. (6), Afd. ii. 1. pl. 2, figs. 79, 80 (1880).

† Ann. Sci. Nat. Zool. (8), ix. pp. 157—167 (1899).

but tends to become simple. In this respect it is very variable, and the maxillæ of the two sides may differ in the same individual. The lobe is simple in the species of *Pontonia* and *Conchodytes* (Plate **57**, fig. 26 *f*) I have been able to examine*, and also in the only specimen of *Periclimenæus robustus* I have dissected (Plate **55**, fig. 20 *f*), in some *Coralliocaris* (as *C. japonicus*, Plate **56**, fig. 23 *f*) though not in others (as *C. macrophthalma*, Plate **56**, fig. 24), and, according to Sollaud, in *Harpilius*. In *Harpiliopsis* it is double, with obsolescent proximal lobule. From the frequent occurrence of reduction in the lobes of this limb in the Carides, it would seem that they are not of great physiological importance. The endopodite is gently swollen at the base, perhaps by the remains of the fifth endite, and the exopodite (scaphognathite) varies in shape and width with the gill-chamber, being broad in depressed forms, particularly in *Harpiliopsis* and *Coralliocaris*.

In the *first maxilliped* (*g* in figs.) two endites—the second and third—are nearly always recognizable, and usually separated by a very distinct notch. The edge of the proximal (second) endite is often indented by a shallower notch. The endopodite is usually simple and tapering, with a stout bristle at a short distance from the tip, which may perhaps represent a joint. In the *Anchistus-Conchodytes* group the endopodite is shorter and blunter, and often shows traces of a transverse joint. At the tip of the exopodite (exognathite) a few small joints may or may not be present, and at its base on the outer side is a fringed lobe (the lobe *a* of Boas) which generally varies in width with the body of the species, though it is wider than this would indicate in *Urocaridella* (Plate **53**, fig. 2 *g*) and some *Urocaris*. The epipodite (mastigobranch) varies greatly in size. Its outer border is usually notched, but in *Periclimenes* the notch is shallow or wanting. It is deep in *Urocaridella*, which is remarkable if it is to be regarded as an unprimitive feature. The lobes separated by the notch may be equal, or the distal one may be longer than the other and pointed.

The *second maxilliped* (*h* in figs.) has the typical caridean form, that is to say, (1) its main axis consists of six joints, owing to the fusion of the basipodite and ischiopodite, (2) the last two joints are bent strongly backwards, so as to lie parallel with the ischiobasipodite, (3) owing to the growth backward (morphologically forward) of a process of the propodite on the outer (morphologically inner) side of the dactylopodite, the latter comes to lie not at the apex of, but along the median side of the propodite. Thus these two joints are compacted into a firm plate, which presents a long median margin, fringed with bristles, against its fellow of the opposite side. To the third of these characters there is an exception in the case of the genus *Harpilius*, where, according to Dana's figure for the type species (*H. lutescens*), there is a very remarkable return to the primitive condition in respect of the position, though not of the shape, of the dactylopodite. This arrangement is approached in at least one species of *Coralliocaris* (*C. superbus*). The exopodite is obscurely annulate in the greater part of its length, and bears at the end a comparatively small number of true joints. The coxopodite carries on the outer side a simple oblong epipodite, and on the median side a knob bearing bristles which probably represents an endite.

* *Pontonia ascidicola* and *Conchodytes meleagrinæ* and *tridacnæ*. Ortmann (Zool. Jahrb. Syst. v. Pl. 37, figs. 9 f., 10 f.) figures a cleft in the maxilla of *P. tyrrhena*.

Its gill will be mentioned later. A swelling which is sometimes present at the base of the coxopodite may represent the precoxal endite.

The main axis of the *third maxilliped* (*i* in figs.) consists, in *Urocaridella* (Plate **53**, fig. 2 *i*), of five joints, the ischiopodite being fused with the meropodite, and the propodite with the dactylopodite. Curiously enough, this arrangement is found also in *Conchodytes* (Plate **57**, fig. 26 *i*) at the other end of the pontoniine series. In all other genera the basipodite is fused with the ischiomeropodite, though the junction is still marked by a notch. The coxopodite bears on the outside a small, rounded epipodite, and often also on the inside a knob with bristles which is perhaps to be regarded as an endite. The exopodite is obscurely annulate and at its end there are usually a few longer segments, which are sometimes true joints but in other cases appear to be marked merely by a change in the width of the organ and the attachment of bristles.

The long joint of the endopodite (ischiomeropodite) is in *Urocaridella* (Plate **53**, fig. 2 *i*) and *Urocaris* (Plate **53**, fig. 3 *i*) straight, with the outer side somewhat swollen at the base. In the other genera it is almost always more or less curved, with the concave side towards the middle line of the body. It is always ribbon-like, and shows throughout the subfamily a tendency to widen. It is narrow in *Urocaridella*, *Urocaris*, *Ancyclocaris*, *Palæmonella*, *Periclimenes*, *Periclimenæus*, and *Pontoniopsis*, though in some species of *Periclimenes* (Plate **54**, fig. 8 *i*) and in *Periclimenæus* (Plate **55**, figs. 19 and 20 *i*) it is a little increased in width. In *Harpiliopsis* (Plate **55**, fig. 21 and Plate **56**, fig. 22 *i*), *Coralliocaris* (Plate **56**, figs. 23 and 24 *i*), and *Anchistus* it is wide or narrow according to species, reaching in some *Anchistus* the greatest width it attains in the subfamily. In *Harpilius* it is wide, but narrows towards the distal end. In *Pontonia* and *Conchodytes* (Plate **57**, fig. 26 *i*) it is broad. The last two joints are always a little narrower than the ischiomeropodite, but are of approximately the same width as it in the species in which it is narrow and in *Coralliocaris*. In *Harpilius*, in some species of *Anchistus*, and in *Harpiliopsis beaupresi*, they remain narrow though the ischiomeropodite is expanded. In *Pontonia* and *Conchodytes* they are wide, though the widening is not equally pronounced in all species. They have always a flat ventral surface but are sometimes, as in *Coralliocaris*, stoutly built. The curving of the ischiomeropodites brings the last two joints of each third maxilliped near to those of its fellow, so that, while the ischiomeropodites lie at the sides of the mouth, with a wide gap between them, in which the second maxillipeds are exposed, the distal parts of the limb lie side by side in front of the mouth region. A further complexity in the arrangement of the parts of the limb is brought about by the fact that the ischiomeropodites are twisted, so that the flat surface of the appendage, which in its distal part is in a horizontal plane, is in the proximal part in a plane between the horizontal and the vertical. This arrangement has the effect of forming a kind of basket below the mouth region, walled in at the sides by the ischiomeropodites, which are of course more efficient in that respect the wider they are, and by the long bristles which project downwards and inwards from the median edges of these joints. In front, the distal part of the limb, with its bristles, affords a surface, horizontally placed below the antennal region while the appendages are outstretched, which by bending can be brought ventrally under the mouth area to complete its enclosure.

The *process of feeding* has not been observed in Pontoniinæ, and as yet we do not even know upon what they feed, though it may be inferred that the species which live in intimate association with sessile or subsessile animals probably share the food of the latter, which consists of minute organisms swept up by ciliary currents from the surrounding water. In regard to the use of the organs around the mouth, something may be gathered from a study of the prawns of the genus *Leander*, in which these organs are very similar to those of the Pontoniinæ in their general structure and arrangement. In *Leander serratus* there are bristles, borne upon ridges of the coxopodite, basipodite, and ischiopodite of the first leg, which complete behind and below the basket under the jaws, but which are less well-developed or absent in Pontoniinæ. Small particles of food may be seized and conveyed by the chelipeds of either pair to the region of the mouth, where they are generally received by the second maxillipeds, though sometimes they appear to be placed directly in charge of more dorsally placed structures, probably the maxillules. A large morsel occasionally appears to be steadied by the legs of the second pair, while those of the first pair tear off fragments and carry them to the jaws, but it is more often placed as a whole within the grasp of the second maxillipeds, which hold it in place while pieces are torn off it by deeper-lying organs, probably in the main by the incisor processes. In handling bulky masses of food the chelipeds are assisted by the third maxillipeds, which bend back their last two joints for the purpose. The third maxillipeds are also capable by the same action of scooping up food and unaided carrying it to the second maxillipeds, between which they sometimes thrust it with their tips. During these processes the basket appears to serve the purpose of keeping the food under control till it has been seized by the second maxillipeds. These are very important organs, and play an indispensable part in passing the food to the mandibles. The animal can still feed if the legs and third maxillipeds have been removed, but if all the other organs be left and the second maxillipeds cut away it is apparently incapable of taking food. The second maxillipeds have three principal movements. In one, the broad flaps in which they end open downwards like a pair of doors and with their stout fringes gather up the food, in another they rotate in the horizontal plane to and from the middle line, in the third the bent distal part of the limbs tends to straighten so as to brush forward any object which lies between them. Frequently these movements are combined. Once the food is past the portals formed by the second maxillipeds its course is hard to trace, but the following seems to be its fate. If it be small in quantity and finely divided, or very soft, it is abandoned to the action of the maxillules, by whose strong, fringed laciniæ it is swept forwards and probably caused to enter the mouth chamber through the slit between the paragnatha*. If it be bulky or tough, the second maxillipeds assist the maxillules in brushing it forwards towards the incisor processes. The action of these latter is not so much a cutting one as a process of tucking the food into the mouth chamber, by first backing outwards and then moving

* Such is the impression made. But it may be that all food is worked into the mouth chamber by the incisor processes, and that the function of the cleft on the metastoma is to enable the paragnatha to part and give room for the admission of large pieces of food.

inwards and rotating upwards. No doubt during this the food undergoes some tearing, and when the mass is large pieces have to be torn off it before they can be swallowed. The palp does not appear to take any mechanical part in the process. If it has a sensory function this is probably not of great importance, for the organ is present and absent in closely related genera in many cases among Carides. Finally, to enter the gullet, the food must pass between the molar processes, and be pounded by them as it goes. Their concave ends are usually found to be clogged with a pasty matter. They must do their work very quickly, for the movement of the mandibles, as judged by that of the incisor processes, ceases very soon after the food leaves the latter. How swallowing takes place is not clear. Parker and Mocquard suggest that the food of Decapod Crustaceans is caused to pass up the gullet by suction from the crop (stomach), but, as I have shown elsewhere*, the case of the land hermit-crabs of the genus *Cœnobita* throws doubt upon this explanation. It may be that the constrictor muscles of the œsophagus play some part in the process.

The first maxillipeds and the maxillæ probably take no very prominent part in manipulating the food. The feeble lobes of the maxillæ are in incessant movement to and from the middle line as they are carried inwards and outwards by the action of the scaphognathite. It seems likely that their sole function is to regulate the motions of the latter. The large lacinia of the first maxilliped is a rather feeble structure with slender, silky bristles, and is not strongly moved during feeding. Probably, by covering the lobes of the maxilla, it prevents them from being clogged by the food.

The part played by the paragnatha seems to be a passive one. The labrum undergoes active movements whose function is probably to aid in keeping the food under the action of the incisor processes.

The exopodites of the maxillipeds are in constant rapid motion, setting up by their activity a strong current forwards from the mouth. No doubt this assists in carrying away the foul water from the gill chambers and the excreta of the green glands poured out at the base of the antennæ. But it has also a significance in the feeding process. From time to time particles are rejected by the second maxillipeds, which kick them violently forwards, the distal parts of the third maxillipeds at the same time straightening so as to admit them to the outgoing stream, by which they are swept away.

It has already been stated that the mouth-parts of the Pontoniinæ, even in the most decidedly commensal species, are not highly modified as compared with those of the free-living Palæmoninæ. For such modifications as exist it is, however, possible to suggest a connection with the nature of the food. The broad third maxillipeds seem better adapted to shepherd a crowd of minute organisms than narrower types of those organs, and the large, hairy laciniæ of the maxillules of the *Pontonia* group perhaps serve the same purpose.

The *legs of the first pair* are chelate, but relatively slender and never of great length. They are alike and equal. Their chelæ are usually of simple form, but in

* Gardiner's Fauna of the Maldives, i. p. 79 (1901).

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several cases (*Periclimenes spiniferus* (Plate **52**, fig. 1 *k*), *P. soror*, etc.) they have a comb-like arrangement of fine teeth on the opposed edges of their fingers, and in others the tips of the fingers are double. The chela usually bears tufts of stiff hairs. The first three joints may show traces of the bristle-bearing ridges found in species of *Leander*.

The *legs of the second pair* are the stoutest limbs of the body, and nearly always longer than the first pair. They may be equal or unequal, alike or unlike, and that sometimes within the limits of one genus. They are rarely of complicated shape. Their fingers have usually some stout teeth on the apposed edges, but sometimes they are blade-like. In *Periclimenes denticulatus* they are edged with numerous fine denticles. In *P. petitthouarsi* and *P. spiniferus* (Plate **52**, fig. 1 *l*) each finger of the larger member of the pair bears a curious pit with raised edges, and in the great chela of *Periclimenæus* (Plate **55**, figs. 19, 20) a knob on one finger fits into a socket on the other, somewhat as in *Alpheus*. Curiously enough, in one of the two species as yet discovered the knob is on the fixed finger, while in the other it is on the "thumb" or movable finger (dactylopodite) as in *Alpheus*.

The stoutness of the limb varies, roughly speaking, with that of the body. In *Urocaridella* (Plate **53**, fig. 2 *a*) and *Urocaris* it is very slender throughout. In *Palæmonella* (Plate **53**, fig. 5 *a*) it is stouter but still slender. In *Periclimenes* it varies in stoutness but is never very heavy. In *Ancyclocaris* it is short and rather stout. In *Periclimenæus* one is massive and *Alpheus*-like in keeping with the general build of the body, and the other smaller and simpler but somewhat of the same type. In *Harpilius lutescens* both are rather slender and insignificant. In *Pontoniopsis* the larger is heavy, but not monstrous, and of fairly simple shape, while the smaller is very slender. In *Harpiliopsis* the palm is long and fairly heavy, and in *Coralliocaris* (Plate **56**, figs. 23 *l*, *l'*) this tendency is enhanced and the chela is a characteristic organ, long and heavy, swollen at the base, and narrowing towards the fingers, which are short. In *Anchistus* it is of moderate size, with parallel sides and fingers of a good length. In *Pontonia* (Plate **57**, fig. 29) and *Conchodytes* it grows heavier, but the palm is still generally of fairly even width and the fingers generally not very short, though in some cases there is an approach to the condition of *Coralliocaris*. The same may be said of *Typton*.

The thumb is on the outer side of the limb, and usually moves in a nearly horizontal plane, but a little upwards or downwards*. Sometimes, however, it becomes almost or quite vertical, and in this case it is generally above the other finger, but may be below, as in *Coralliocaris japonica* (Plate **56**, fig. 23 *l*).

In many cases, especially in *Periclimenes* (Plate **52**, fig. 1 *a*), one or more stout spines are found at the end of the "wrist" (carpopodite), or "arm" (meropodite), or both.

The *mode of use of the chelipeds* is as yet unknown. Presumably those of the first pair serve as cleaning organs, as they certainly do in *Leander*. They are no doubt also used to convey food to the mouth, as in *Leander*. The chelæ of the larger pair are perhaps, as in other cases, used for seizing and tearing masses of food and as weapons of offence both against prey and against foes; but they seem unsuited for handling

* This fact is exaggerated in many of the figures, by slightly twisting the hand, in order to show the shape of the fingers.

the minute organisms which must form the food of some species, and it is hard to imagine that a *Conchodytes*, for instance, can have many enemies against which such weapons would be of any avail. They may have sexual uses, but rarely differ in the sexes. The peculiar features which they present in the several species are quite unexplained, and the study of this limb in relation to the habits of the species presents an interesting field of observation.

The *legs of the last three pairs* are similar in all but minor details. In *Urocaridella* and some species of *Urocaris* they are directed forwards as in *Palæmon*, but in *Urocaris psamathe* there appears a change in their position which increases as the build of the body becomes heavier, and is probably to be regarded as an adaptation to walking. The basipodite is here curved so that, whereas the coxo-basipodite joint is transverse to the main axis of the body, the basi-ischiopodite joint tends to become longitudinal, and the limb is thrown outwards, and thus the body has a wider area of support. A row of movable spines is often found on the lower side of the propodite (Plate **52**, fig. 1 *m*), and sometimes there are spines on other joints. The dactylopodites vary greatly. In the more lightly built species they are generally slender, nearly straight, and simple (Plate **52**, fig. 1 *m*). In *Harpilius*, *Harpiliopsis*, *Coralliocaris*, and *Conchodytes*, they are strongly curved. *Coralliocaris* (Plate **56**, fig. 23 *m*) has at the base of the joint on the under side a curious prominence which is usually more massive than the terminal claw. In *Stegopontonia* this prominence is paired. *Conchodytes* (Plate **57**, fig. 26 *m*) has a swelling in the same position. In members of various genera the end-claw may be duplicated by a spine underneath it, so that the limb becomes "biunguiculate" (Plate **55**, fig. 19 and Plate **57**, fig. 26 *m*). In some cases the end-claw is exceedingly sharp, in others it is stouter and blunter. No doubt each of these peculiarities is an adaptation to the substratum upon which the species possessing it moves. Most of them are not as yet susceptible of explanation, but when the claws are both sharp and curved they are often dug into the soft tissues of the host.

The *abdominal limbs* (Plate **52**, fig. 1 and Plate **53**, figs. 2 *o*—*o*″) are of the ordinary caridean type and show few remarkable features. The *appendix interna* is present on the second to fifth pairs in both sexes, and on the second pair of the male there is an additional process beside the *appendix*. The endopodite of the first limb is always smaller than that of the others, and its inner edge is often crumpled over. *Urocaridella* is remarkable for having an *appendix interna* on this limb. This feature occurs also in *Amphipalæmon* and is one of many indications of a relationship between the Anchistioididæ* and the Palæmonidæ.

The fullest *gill formula* found among the Pontoniinæ is that of *Urocaridella* and *Ancyclocaris aberrans*. Here there is a pleurobranch for each leg, an arthrobranch for the third maxilliped, and a podobranch on the second maxilliped (Plate **53**, fig. 2 *h*), with a mastigobranch on each of the maxillipeds. A tiny lobe above the base of the mastigobranch of the second maxilliped is perhaps the last vestige of an arthrobranch. A second group of genera, comprising *Urocaris*, *Periclimenes*, *Harpiliopsis*, *Coralliocaris*, *Palæmonella*, *Pontonides*, *Periclimenæus* and *Anchistus*, have lost the podobranch of the

* See p. 405 in this volume.

second maxilliped and reduced in varying degrees the arthrobranch of the third maxilliped (*i* in figs.). In *Periclimenes*, however, as Sollaud has shown, there is often a vestige of the podobranch of the second maxilliped in the form of a finger-shaped process at the base of the mastigobranch (Plate **52**, fig. 1 *h*). I have not been able to satisfy myself of the presence of this process in some of the species I have examined, but it is possible that some trace of it is always present. A very minute protuberance found in the angle between the mastigobranch and the exopodite in *Urocaris*, *Harpiliopsis*, *Periclimenæus* and *Anchistus* may have the same significance. Curiously enough, *Palæmonella*, in other respects the most primitive of these genera, shows a greater reduction of the gill of the third maxilliped than *Coralliocaris* or *Harpiliopsis*, and has no vestige of that on the second maxilliped. In *Periclimenæus* and *Anchistus* the arthrobranch of the third maxilliped is represented by a slightly folded lobe. In *Harpilius*, *Pontonia*, *Conchodytes* and *Typton* the gills of both maxillipeds are entirely lost, save for a hardly recognizable vestige at the base of the third maxilliped of *Pontonia*.

It will be seen that, while all Pontoniidæ have undergone some reduction of the gill formula as compared with other Palæmonidæ, within the subfamily a loss of gills, roughly speaking, accompanies the adoption of a less active mode of life. Where there is less need for active respiration there is less provision of respiratory organs. In some cases, however (*Urocaris*, *Palæmonella*, *Periclimenes*), the loss of gills is in advance of the change of habits, at least in so far as that be indicated by the build of body and limbs. From this fact Sollaud draws the conclusion that the reduction of the gill apparatus is the cause rather than the effect of the altered mode of life. In that case, it has presumably come about by meristic variation, more or less fortuitously, and the animals have survived by the adjustment of their habits to their anatomy rather than by the selection of variations in their anatomy which were suitable to their habits. The theory is attractive, and consonant with a good deal in modern biological speculation, but before it can be adopted more must be known about the habits of the prawns. The build of body is not always an indication of the mode of life, either among the Pontoniinæ or in other prawns. *Metapenæus commensalis*, for instance, lives in the zone of protection of a large sea-anemone, though its general appearance is that of allied species which are believed to be free-living, and various gracefully built species of *Palæmonella* and *Periclimenes* are commensal with feather-stars. It may be after all that in the Pontoniinæ a change of behaviour has been the forerunner of structural change, and that the long series of modifications which we have traced in all parts of the body of these prawns, by whatever process of variation or selection it may in detail have been brought about, is but the result of congenital laziness in an environment which offers to the sluggish endless opportunities of retreat.

The Colours of the Pontoniinæ.

Most species of Pontoniinæ have been described on data obtained only from spirit specimens, and information concerning the colouration of the subfamily is consequently

limited*. It is certain however that they vary greatly in this respect, the animals being striped, spotted, or suffused in very different ways and with very different colours, while the differences between species are often as great between species of the same genus as between those of different genera. In the cases at present known the colours are usually gaudy and conspicuous when the prawns are removed from their proper environment, though, in some instances at least, their colouration harmonizes very strikingly with that of their natural surroundings. Nothing is known as to the colour changes which doubtless occur in the lifetime of the prawns, or as to the way in which there arises a correspondence between the colouring of the individual and that of its surroundings, or as to the value this may have to the prawn.

On Adaptation.

It will be clear, from various statements in the preceding pages, that our knowledge of the significance of peculiar features in the Pontoniinæ is at present very limited. Yet it may not be useless even now to consider the problem they present, if only because the alteration which is in progress in our views as to the mode of origin of such features may well result in an underrating of their importance in the economy of the organism. It has, for instance, quite lately been said that "to see fitness everywhere is mere eighteenth century optimism." Now, as a repudiation of the conception of an all-but personified "environment," which by "selection" forces organisms into a mould predetermined by itself, this statement is undoubtedly justified. But it may also convey a belief that an appreciable proportion of the characteristic features of organisms is not correlated with peculiarities in their modes of life, and in this sense it is of much more doubtful validity.

There was a time when the structural peculiarities of organisms were widely held to be due to the direct action of their environment in bringing them into harmony with itself, by means of the plasticity of the individual and the inheritance of the characters so "acquired." Thus every feature was shaped to meet some demand of an environment which could not be escaped, and each played its part in ensuring the viability of the species. That conception was replaced by one in which the organism was allowed more initiative, in that it presented numerous small but ready-made modifications to its environment, by which some of them were then "selected" to become the characters of an altered race. This view had in turn to be modified in the direction of attributing a greater importance to the organism itself, since it was discovered that only some of the variations presented by the organism were heritable, and that these were fixed and incapable of dilution or summation. Finally, it has to be recognized that what is selected is not this or that "character," but the organism as a whole, with its powers of adapting itself to the world by various means. Thus the part held to be played by the environment in the production of any single character has become less and less, and therewith has waned the belief that every character plays some part in the

* Dana, Nobili, Potts, Rathbun and others give information concerning the colours of various species.

struggle for existence, since that is too often still regarded as the activity of a machine-like organism in the face of a fixed and unavoidable environment.

Now it is true enough that the structural "fitness" of an organism does not consist in its characteristics having arisen in response to the fixed demands of an environment. But this does not mean that each of them is not caused to play its part in that reaction with the world which constitutes the life of the organism, including the habit of seeking an environment and maintaining itself there by the necessary measures. These habits are without doubt as modifiable, both in the individual and in the race, as any other characteristic of the organism, and one of the conditions of the persistence of any given structural modification is that it should not exceed the limits of the power of adjustment which is given by this susceptibility of modification of habit. So long as the structural alteration does not outrun the physiological possibilities, fitness is maintained, and it is incredible that this can ever be due to the alteration being indifferent to the life of the organism. Some disturbance it must cause, whether in the internal or in the external physiology, and in the long run a disturbance in internal physiology will cause a modification in behaviour, as in the amount of food taken, or in the sheltering of an animal which by any cause becomes deprived of its agility. Any belief to the contrary can only arise from the fact that the importance to the economy of the organism of any given structural modification by no means necessarily corresponds with its conspicuousness in the eyes of the human observer.

It is, of course, also the case, though this is beside the present point, that alterations in behaviour can only take place within limits set by the structure of the organism, though it is not the case that every such change must involve a modification in the structure of the organs used. Finally, it is still true that the organism must come to terms with its world; but that is not to say that it is dependent upon an inevitable environment, or that it can maintain itself in a given set of surroundings only by a fixed behaviour. Adaptation, in short, is a relation between structure and habit, and only secondarily between structure and environment; and there is no feature of an organism the investigation of which can safely be regarded by the naturalist as without significance, and relegated by him to the student of variation.

The Distribution of the Pontoniinæ.

The majority of the Pontoniinæ are members of the shallow water fauna of the tropical and subtropical Indopacific. Six species occur in the Mediterranean, six on the west coast of America, eight in the Western Atlantic, and one in South Australia. Three of the Mediterranean species are also recorded from British waters. *Urocaris longicaudata* and *Palæmonella tenuipes* are stated to occur both in the West Indies and in the Indopacific. Pontoniinæ appear to be entirely absent from the colder seas. Most are undoubtedly benthic, but very possibly a few of the more lightly-built forms, such as *Urocaris*, will prove to belong to the plankton. One species of *Urocaris* is bathypelagic, *Coutierea* lives in moderately deep water, probably on the bottom, *Palæmonella laccadivensis* is dredged in 100—600 fathoms, and *Periclimenes tenellus* in

230 fathoms. Most of the subfamily are to some extent cryptozoic, and a great many actually commensal. A sketch of the distribution of this habit within the group has already been given on pp. 329, 330. Unfortunately, little is known of the behaviour of the Pontoniinæ or of their relation to the animals which serve as their hosts. A detailed study of this subject, which could only be made in the field, would undoubtedly give very interesting results.

The Genera of the Pontoniinæ.

The genera of the Pontoniinæ may be briefly characterized by means of a key, as follows:

I. Body very slender and compressed. Thorax without swelling. 6th abdominal segment much elongate. Outer flagellum of antennule deeply cleft. A gill may be present on the second maxilliped.

A. Mandibular palp present. Gill on second maxilliped. Rostrum toothed below.

Urocaridella Borradaile, 1915.

B. No mandibular palp. No gill on second maxilliped. Rostrum without teeth below.

Urocaris Stimpson, 1860.

II. Body moderately stout, not compressed. Thorax of female swollen dorsally. 6th abdominal segment short. Outer flagellum of antennule deeply cleft. A gill may be present on the second maxilliped. [No mandibular palp.]

Ancyclocaris Schenkel, 1902.

III. Body never very slender, or much compressed. Thorax without swelling. 6th abdominal segment never much elongate. Outer flagellum of antennule rarely deeply cleft. No gill on second maxilliped.

A. Mandibular palp present.

Palæmonella Dana, 1852.

B. No mandibular palp.

1. Scale of second antenna rudimentary.

Typton Costa, 1844.

2. Scale of second antenna well developed.

i. Gracefully-built forms, with body little if at all depressed, rostrum well developed, and almost always toothed, slender legs, whose dactylopodites are usually narrow and never hook-like, and antepenultimate joint of third maxilliped narrow (except *P. brocki*, where it is of moderate breadth).

α. Eyes subspherical. Rostrum horizontally expanded.

Pontoniopsis Borradaile, 1915.

β. Eyes not subspherical. Rostrum vertically expanded.

(1) Body and chelipeds *Palæmon*-like. Dactylopodites of walking legs usually narrow.

Periclimenes Costa, 1844.

(2) Cephalothorax deep and flat-sided, recalling *Alpheus*. One of second chelæ very heavy, with short fingers bearing a knob and socket arrangement. Dactylopodites short, broad, and biunguiculate.

Periclimenæus Borradaile, 1915.

ii. Clumsy-bodied forms, with body obviously depressed, at least in female, rostrum usually in some way reduced and often toothless, stout legs, ending in short, usually hooked dactylopodites, and antepenultimate joint of third maxilliped moderately or very broad.

α. Rostrum straight or upcurved, diminishing in normal fashion to a sharp point, usually toothed, but generally with little or no ventral crest. Body not very clumsy. Third maxilliped not strongly twisted.

(1) Dactylopodites of walking legs without basal protuberance. Last two joints of third maxilliped narrow and usually contrast strongly in width with antepenultimate.

(*a*) Third maxilliped with arthrobranch. Second maxilliped with last joint mediad of penultimate.

Harpiliopsis n. gen.

(*b*) Third maxilliped without arthrobranch. Second maxilliped with last joint posterior (distal) to penultimate.

Harpilius Dana, 1852.

(2) Dactylopodites of walking legs bear a basal protuberance, usually large. Last two joints of third maxilliped do not contrast strongly in width with antepenultimate, and are usually broad.

(*a*) Rostrum not very broad. Basal protuberances of the dactylopodites simple.

(i) Rostrum very long. Enormous supraocular spines present. Abdomen carinate.

Coutierea Nobili, 1902.

(ii) Rostrum not very long. Supraocular spines absent or not very large. Abdomen not carinate.

Coralliocaris Stimpson, 1860.

(*b*) Rostrum very broad. Basal protuberances of dactyles paired.

Stegopontonia Nobili, 1906.

β. Rostrum downcurved, toothless, usually blunt pointed, sometimes with a sharp point of abnormal fashion, usually with good ventral crest. Body usually very clumsy. Third maxilliped strongly twisted.

(1) Last two joints of third maxilliped narrow.
Anchistus Borradaile, 1898.

(2) Last two joints of third maxilliped broad.

(a) No exopodites on maxillipeds. Eyes of good size.
Pontonides n. gen.

(b) Exopodites on maxillipeds. Eyes small.

(i) Dactylopodites of last three legs straight, without basal prominence.
Pontonia Latreille, 1829.

(ii) Dactylopodites of last three legs curved, with basal prominence.
Conchodytes Peters, 1851.

There can be no doubt that the most primitive genus of Pontoniinæ is *Urocaridella*. This very remarkable form has almost all the features which must have characterized the earliest members of the group. The complete retention of the caridoid facies, the forward direction and simple form of the legs, the gill formula only less by one small pleurobranch than that of *Leander* or *Desmocaris*, the mandibular palp, the straight, slender third maxilliped, the deeply-cleft outer flagellum of the antennule, all tell the same tale. Yet *Urocaridella* can certainly not be considered ancestral to the rest of the subfamily. It is specialized, probably for pelagic life, in its compression, in the peculiar form of the abdomen with the long sixth segment and projecting third segment, and in the long, upcurved rostrum. There can, again, be no doubt that *Urocaris* arose from *Urocaridella*, through such species as *Urocaris psamathe*, by the loss of the mandibular palp, of the gill on the second maxilliped, and of the lower teeth of the rostrum. The rest of the Pontoniinæ, however, must have taken independent origin from the common ancestor of the subfamily, to which *Urocaridella* remains nearer than they, though it is not transitional to them. *Ancyclocaris* represents such a line of independent descent. By the retention, in one species, of the gill on the second maxilliped, by the narrow third maxilliped, and by the deeply-cleft outer flagellum, it is linked directly with the ancestral form, for the lanceolate rostrum and some features of the abdomen make a descent through *Urocaridella* impossible, but it has lost the mandibular palp, and its stout body and legs, with the curved dactylopodites, show an interesting parallel to *Harpiliopsis* and allied genera. Probably, however, this is due only to a somewhat similar mode of life. The hump on the back of the female is a peculiarity which does not recur in the subfamily.

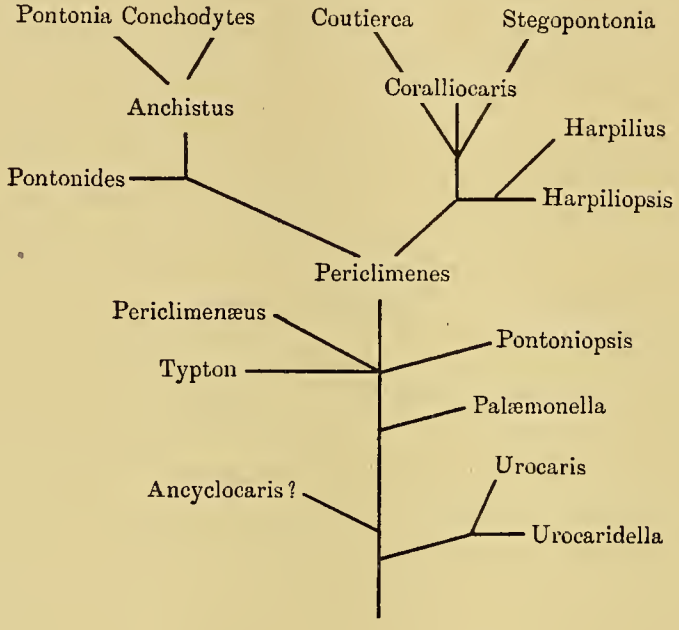
The remaining genera probably represent a third line of descent, through a form resembling *Palæmonella* and *Periclimenes*, from which *Periclimenes* has departed in the loss of the mandibular palp and *Palæmonella* in the loss of the vestige of the gill

of the second maxilliped and the greater reduction of that of the third maxilliped. In other respects there is no difference between these closely related genera. While, however, *Palæmonella* does not yet appear to have given rise to any daughter genera, *Periclimenes* represents a central stock from which groups of genera diverge in several directions. *Periclimenæus* is an interesting modification of this stock in which some of the features of *Alpheus* are reproduced. *Pontoniopsis* represents a second departure from the same stock. *Anchistus, Pontonia* and *Conchodytes* form a third group, characterized by degeneration in connection with the habit of living in the mantle cavity of bivalves and ascidians. The species described by Pesta as *Marygrande mirabilis*, which is however an *Anchistus*, shows the earliest stage in this degeneration. Its body is still fairly slender and compressed, but the downcurved, toothless rostrum, the stout legs, the great chela, and the broad joint of the third maxilliped betray the tendency which is increased in other species of *Anchistus* and leads eventually through *Pontonia* to *Conchodytes*, where it culminates in *C. meleagrinæ*. Some of the species of *Anchistus* retain, in the form of the long joint of the third maxilliped and in a minute dentation of the rostrum, primitive features lost by *A. mirabilis*. It will be recalled that *Anchistus* has a vestige of the gill of the third maxilliped which is lost in *Pontonia* and *Conchodytes*, and that a peculiar breadth and hairiness of the laciniæ of the maxillule are also less marked in the former than in the latter two of these genera. Possibly the point of origin of this group was somewhere in the neighbourhood of the coral-haunting *Periclimenes aurantiacus*, which has a toothless rostrum. *Pontonides* seems to have arisen near this point. A fourth group of forms probably derived from *Periclimenes* is presented by *Harpiliopsis, Harpilius, Coralliocaris, Coutierea*, and *Stegopontonia*. These are sluggish, generally coral-haunting forms, but not internal commensals. In them the legs are stout, with hooked dactylopodites, but the body, though more depressed than in the *Pontonia* group, is less swollen and degenerate. The rostrum loses in depth, but is straight and nearly always dentate, and the maxillules are of quite a different type. In *Harpiliopsis* and *Coralliocaris* the gill of the third maxilliped is comparatively well developed, but in *Harpilius* it is lost, according to M. Sollaud. The members of this group diverge more than those of the second group, but it is not necessary here to recapitulate their differences, which are given in the key above. *Harpiliopsis* is the most primitive of them, and it is quite impossible to reconcile the evidence either of its bodily habitus or of its maxillule with any theory of a descent common to it and *Anchistus*. Possibly it may have taken origin somewhere in the neighbourhood of *Ancyclocaris*, but it seems more likely to have arisen from *Periclimenes*. *Harpilius*, though outwardly it presents no very remarkable feature, is, in its loss of a gill and in the peculiar form of its second maxilliped, perhaps the most aberrant of all. *Coralliocaris* shows in its third maxilliped, its second cheliped, and the dactylopodites of its walking legs, certain convergences with *Conchodytes*.

The affinities of *Typton* are doubtful. Its supraorbital spines* and narrow third

* It is possible that these spines are not present in *T. bouvieri*. Nobili states in his preliminary description of the species that it has "ocular" spines, and in a later account that antennal spines are present, but in his figure he shows neither.

maxilliped are primitive features. On the other hand, the uncleft condition of the outer flagellum of its antennule is probably an exaggeration of one of the secondary features of the Pontoniinæ. Its vestigial antennal scales and small rostrum are no doubt adaptations to its habitat, and in any case are without parallel in the subfamily. Its reduced gill formula might be expected from its habits, and need not indicate any affinity with *Conchodytes*. Its heavy, compressed body with slender walking legs ending in biunguiculate dactylopodites, its large chela, and, very distantly, its rostrum, rather suggest *Periclimenæus*, but in view of other differences this is probably a convergence. It is perhaps best regarded as independently evolved from the ancestor of *Periclimenes*.



On some difficult questions in Phylogeny.

The making of phylogenetic trees, once a favourite pastime of zoologists, has of late years come under the censure of superior persons, on the ground that we know too little about the mode in which evolution takes place to speculate successfully as to its course. Yet to represent in a graphic manner the lines of resemblance and difference within zoological groups is a practice which dates from before the acceptance of the evolutionary theory, and is not without its convenience even in these days. Moreover, the objections to diagrammatic phylogeny apply also to any form of classification which is not purely empirical, and especially strongly to the attempt so to construct "keys" that they shall as far as possible represent real affinities. One of the difficulties which occur in such cases is prominent in the Pontoniinæ. It is presented by numerous instances in which classifications according to two or more different features cross one another, so that alternative arrangements are suggested. When one of these arrangements has the advantage of illustrating also the verdicts of several further characteristics the solution is easy, but this is often not the case. I have already described an instance

of this in another group of Crustacea* and have remarked on the appearance it presents of the kaleidoscopic distribution in several ways of a set of pairs of characters, and called attention to its suggestion of Mendelism. A simple case of this sort occurs among the members of the subgenus *Falciger*, where it is hard to decide whether the primary grouping of the species should be on the ground of the presence and absence of the supraorbital spine or on the shape of the rostrum. Many other such cases may be detected in the keys which are given later in this paper. Another form of the same difficulty arises in the sporadic distribution of a character in circumstances which make it impossible to trace direct connection by descent between the species in which it occurs, except by means of other species from which it must have been absent. This is the case, for instance, with the supraorbital spine throughout the subfamily, and with the denticulation of the fingers of the first leg in several *Periclimenes*.

In earlier days these phenomena would have been even harder of explanation than they are at present, when convergence is receiving more attention than formerly, and Mendelism has risen over the zoological horizon. In many cases close examination of features which at first appear to be due to repetition reveals, either between the fully evolved organs or between stages that lead up to them, differences which show that we are dealing with convergence. In others, the suggestion of Mendelism is probably correct, the feature in question having been suppressed over a series of generations by the absence of some factor necessary for its development or the presence of some hostile factor. It may, indeed, be doubted whether much of what is known as convergence in organisms be not rather due in this way to Mendelism. A further question, however, arises here. Is the sporadic repetition of such a feature, for instance, as the supraorbital spine, in apparently identical reincarnation, due to the releasing of the same "factor," which, once lost, cannot be regained, or is it brought about by a less organized tendency of the mechanism of development to fall into an identical condition from time to time? Far though we be from answering them, these questions are not without interest for others than the systematist. But it is doubtful whether they would be asked if phylogenetic speculation were regarded as wholly a waste of time.

Another problem which is continually suggesting itself concerns the mode in which special features arise and disappear. This has been generally assumed to take place by the gradual elaboration of a rudiment into the highly developed organ, and its loss, when it has outlasted its usefulness, by a series of vestigial stages. Now in some cases it is certainly possible to trace a set of incomplete forms of an organ, and it is justifiable to regard these as either rudimentary or vestigial, though it is often hard or impossible to choose one or other of those alternatives. As instances of such phenomena within species there may be quoted the various forms of armature of the finger of the great chela in *Harpiliopsis depressus*, where stages in the perfection of a cutting flange may be seen, and the varying degrees of inequality of the legs of the second pair in *Coralliocaris graminea*. It is easy to imagine that in either of these cases one form of the organ might come to persist to the exclusion of the others. Within the limits of a genus, the same thing may be seen in regard to the remarkable protuberance

* On the Genera of the Dromiidæ, Ann. Mag. Nat. Hist. (7), xi. p. 303 (1903).

on the dactylopodites of the walking legs of *Coralliocaris*, of which rudimentary or vestigial stages are shown by the subgenus *Onycocaris*, and in the horns of the eyes of *Corniger*, while the subfamily as a whole presents, from genus to genus, a very pretty example of the loss of an organ by gradual stages in the reduction of the arthrobranch of the third maxilliped, from the well-formed gill of *Urocaridella* to the evanescent lobe of *Pontonia*. But there are other cases in which an organ is always present in the same degree of perfection. This is perhaps not very remarkable, for instance, in the peculiar armature of the fingers of the chelæ of certain *Periclimenes*, such as the pits of *P. petitthouarsi* and *P. spinifera* or the combs of the same and certain other species, where imperfect stages may well have disappeared; but it is most striking in the many cases of well-formed and characteristic spines on the limbs and body which come and go throughout the subfamily without ever a trace of rudimentary or vestigial stages. Of such facts as these any theory of evolution must take account.

Finally it is necessary to state that even less conception can be formed of the nature of a "species" in the Pontoniinæ than in many other groups of animals. We have not the slightest knowledge as to what degree of fertility exists between the assemblages of individuals to which this name is given, and have not even the assurance that some of them are not merely allelomorphs. The attempt has been made in some instances to recognize certain entities as "varieties," but as none of these are connected by intermediate individuals I have felt bound, in accordance with principles which I have stated elsewhere*, to class them all in the same temporary category as the "species."

The Species of Pontoniinæ.

In the following lists the species of the subfamily at present known are arranged under their genera with a key to the species of each genus.

Genus Urocaridella Borradaile, 1915.

Ann. Mag. Nat. Hist. (8), xv. p. 207.

Definition: Body slender, much compressed; sixth abdominal segment elongate; rostrum long, slender, upcurved, with teeth above and below; outer flagellum of antennule deeply cleft; antennal scale long, narrow; mandible with palp; second maxilliped with podobranch, and last joint mediad of preceding joint; third maxilliped slender, with arthrobranch; legs very slender, directed forwards, with simple, slender, nearly straight dactylopodites; first abdominal limb with *appendix interna*.

Type: *Urocaridella gracilis* Borradaile, 1915 (Plate **53**, fig. 2).

Ann. Mag. Nat. Hist. (8), xv. p. 210.

Definition: Rostrum nearly twice as long as carapace, much upcurved, excavate at base, its formula $\frac{8-10}{10-12}$, one of the dorsal teeth standing in the middle of the

* Gardiner's Fauna of the Maldives, vol. i.

carapace, two, large, standing on a crest over the orbit, two to four, small, near antennule, three isolated near the tip, most of ventral teeth large and set on a crest between the antennules; antennal and hepatic spines present, the latter nearly in the branchiostegal position; antennular stalk three-quarters of length of antennal scale, its basal joint not much expanded, with stylocerite and distal spine small, the second joint shorter than the third, the second and third joints together shorter than the first; basipodite of antenna with very small spine, scale not half length of rostrum, slightly outcurved, its sides converging slightly towards the end, which is subtruncate, its subterminal spine not reaching the end, stalk of antenna more than half the length of first joint of antennule; third maxilliped reaching or outreaching end of second joint of antennule; first leg outreaching antennal scale by fingers, its wrist and palm subequal, fingers a little longer, its arm equal to wrist and palm together; second legs equal and similar, outreaching antennal scale by hand and part of wrist, fingers rather longer than palm, wrist more than half length of palm, arm equal to wrist and palm together, all joints unarmed; walking legs long, slender, with spines under the propodite, the longest at the end, dactylopodites long, nearly straight, simple; telson longer than sixth abdominal segment, shorter than uropods.

Length of longest specimen, 40 mm.

Maldive Is.

Genus Urocaris Stimpson, 1860.

Proc. Ac. Philadelphia, 1860, p. 39. Kingsley, Ib., 1879, p. 383 (1880). Rathbun, Bull. U. S. Fish Comm. xx. II. p. 126 (1901).

Definition: Body slender, much compressed; sixth abdominal segment elongate; rostrum with a toothed crest above but toothless below; outer flagellum of antennule deeply cleft; antennal scale long, narrow; mandible without palp; second maxilliped without gill; third maxilliped slender, with arthrobranch; legs very slender, their dactylopodites little curved.

Key to the species of *Urocaris*:

I. Rostrum very long and slender and much upcurved.
U. psamathe de Man, 1902.

II. Rostrum of moderate length, never very slender, hardly if at all upcurved.

A. Rostrum has high, arched dorsal crest.
U. infraspinis Rathbun, 1902.

B. Rostrum has low dorsal crest.

1. Rostrum arched, with concavity below. Third abdominal segment projects behind.

a. Two teeth of dorsal crest stand behind orbit. Walking legs biunguiculate.
U. longicaudata Stimpson, 1860.

b. Five teeth of dorsal crest stand behind orbit. Walking legs have simple dactylopodites.

U. æsopius (Bate), 1864.

2. Rostrum straight. Third abdominal segment does not project behind.

a. Rostral formula $\frac{7}{0}$. Second leg of great length.

U. longipes Stimpson, 1860.

b. Rostral formula $\frac{10-11}{3}$. Second leg rather short.

U. korni (Lo Bianco), 1903.

1. (Type.) *Urocaris longicaudata* Stimpson, 1860.

Proc. Ac. Philadelphia, 1860, p. 39. Kingsley, Bull. Essex Inst. x. p. 65; Proc. Ac. Philadelphia, 1878, p. 330. Rathbun, Bull. U. S. Fish Comm. xx. II. p. 126 (1901). ? Pearson, Rep. Ceylon Pearl Fisheries, iv. p. 78, Pl. 1, fig. 5 (1905).

Specimens in the present collection of a *Urocaris* resembling this species do not agree with the descriptions given by the authorities cited, in the following points: (1) the rostrum outreaches the second joint of the antennular peduncle, (2) the flagella of the antennule are much longer than its stalk, (3) the first leg outreaches the antennal scale by the fingers, and the fingers and palm are subequal, (4) the fingers of the second leg are rather shorter than the palm. Further investigation of the reported occurrence of *U. longicaudata* in the Indian Ocean is desirable.

Carolina to Brazil. Western Indian Ocean?

2. *Urocaris longipes* Stimpson, 1860.

Proc. Ac. Philadelphia, 1860, p. 39.
Ousima I., 20 fms.

3. *Urocaris æsopius* (Bate), 1864.

Anchistia æsopia Bate, Proc. Zool. Soc. Lond., 1863, p. 502, Pl. 41, fig. 5 (1864).
St Vincent Gulf.

4. *Urocaris infraspinis* Rathbun, 1902.

Proc. U. S. Mus. xxiv. p. 903; Decap. Crust. N.W. America, p. 31 (1904).
California to Mexico.

5. *Urocaris psamathe* de Man, 1902 (Plate **53**, fig. 3).

Abh. Senckenb. Ges. xxv. p. 816, Pl. 25, fig. 51.
Ternate.

6. *Urocaris korni* (Lo Bianco), 1903.

Anchistia Kornii, Lo Bianco, Mitt. Stat. Neapel, xvi. p. 250, Pl. 7, fig. 13 (1903).
Periclimenes Korni? Kemp, Journ. Mar. Biol. Assoc. (N. S.) viii. p. 411 (1910).
Mediterranean. Bay of Biscay? Bathypelagic, 400—600 fms.

Genus Ancyclocaris Schenkel, 1902.

Verh. Naturf. Basel, xii. p. 503. Nobili, Bull. Sci. Fr. Belg. xl. p. 52 (1906).

Definition: Body rather stout; cephalothorax with dorsal swelling in female; sixth abdominal segment short; rostrum deep, of moderate length, lanceolate, with about half-a-dozen teeth above and one or two below; eyes small; outer flagellum of antennule deeply cleft; antennal scale broad; mandible without palp; second maxilliped with or without podobranch*, and with last joint mediad of preceding joint; third maxilliped slender, with arthrobranch; legs stout, with short, simple, curved dactylopodites.

The species of this genus are closely related, and the distinctions between them are hard to gather from the published descriptions. Possibly some of them will eventually have to be united. So far as can be learned from the diagnoses and figures given by their authors, they differ in the points stated in the following key:

Key to the species of *Ancyclocaris*:

I. Dorsal swelling of cephalothorax steep. Uncleft region of outer antennular flagellum 8-jointed. Hepatic spine farther forward than usual. [Outer edge of antennal scale converging towards inner. R. $= \frac{5-6}{1}$. Fingers of second leg gaping a little.]

A. aberrans (Nobili), 1904.

II. Dorsal swelling of cephalothorax gradual. Uncleft region of outer antennular flagellum 5—7-jointed. Hepatic spine not farther forward than usual.

A. All rostral teeth in front of orbit. Fingers of second leg gaping a little. [R. $= \frac{6}{1}$. Outer edge of antennal scale straight.]

A. latirostris (Lenz), 1905.

B. One tooth of rostrum behind orbit. Fingers of second leg not gaping appreciably.

1. R. $= \frac{6}{1}$. Cephalothorax with large swelling in middle of its length. Outer edge of antennal scale nearly straight †. Uncleft region of outer antennular flagellum 7-jointed.

A. hermitensis (Rathbun), 1914.

2. R. $= \frac{6}{2}$. Cephalothorax with low swelling in hinder region. Outer edge of antennal scale markedly convex. Uncleft region of outer antennular flagellum 5—6-jointed.

A. brevicarpalis Schenkel, 1902.

1. (Type.) *Ancyclocaris brevicarpalis* Schenkel, 1902.

Verh. Naturf. Basel, xiii. p. 563, Pl. 13, fig. 21.

Macassar.

* Nobili (Bull. Sci. Fr. Belg. xl. p. 52) very definitely states that *A. aberrans* has a gill on the second maxilliped. I have not been able to find this in *A. hermitensis*.

† See below, p. 356.

2. *Ancyclocaris aberrans* (Nobili), 1904.

Palæmonella aberrans, Nobili, Bull. Mus. Paris, 1904, v. p. 233.

Ancyclocaris aberrans, Nobili, Bull. Sci. Fr. Belg. xl. p. 52, Pl. 4, fig. 9 (1906); Ann. Sci. Nat. (9), iv. p. 64 (1906).

Jibuti, under protection of *Discosoma giganteum*. Persian Gulf.

3. *Ancyclocaris latirostris* (Lenz), 1905.

Harpilius latirostris, Lenz, Abh. Senckenb. Ges. xxvii. p. 380, Pl. 47, fig. 14 (1905).

Ancyclocaris (?) *latirostris*, Nobili, Ann. Sci. Nat. (9), iv. p. 65 (1906).

? *Eine nicht bestimmte Palæmonide*, Richters, Decap. Mauritius, Pl. 18, figs. 10, 11 (1880).

E. Africa. Mauritius ?

4. *Ancyclocaris hermitensis* (Rathbun), 1914.

Periclimenes hermitensis, Rathbun, Proc. Zool. Soc. Lond., 1914, p. 655, Pl. 1, figs. 1—3.

Monte Bello Is. Torres Straits, under protection of *Discosoma*, whose mouth it enters at times.

Miss Rathbun figures the antennal scale of this species without a distal spine. In specimens from Torres Straits which resemble hers in every other respect, including the colour pattern, the outer edge of the scale is straight from the base to a well-formed distal spine, and then curves abruptly inwards.

Genus Palæmonella Dana, 1852.

U. S. Explor. Exped. Rep. xiii. i. p. 582. Kingsley, Proc. Ac. Philadelphia, 1879, p. 425 (1880). Bate, "Challenger" Macrura, p. 786 (1888). Ortmann, in Spengel, Zool. Jahrb. Syst. v. p. 513 (1890); Bronn's Thierreich, v. ii. p. 1132 (1899).

Definition: Body slender; sixth abdominal segment of moderate length; rostrum straight or a little upcurved, shallow, with several teeth above but few below; outer flagellum of antennule deeply cleft or not; antennal scale of good length and moderate breadth; mandible with palp; second maxilliped without even a vestige of podobranch, and with last joint mediad of preceding joint; third maxilliped narrow, with vestigial arthrobranch; legs slender, with slender, slightly curved dactylopodites, biunguiculate or not in last three pairs.

Key to the species of *Palæmonella*:

I. Second leg unarmed: its wrist less than half the length of its hand.

A. No hepatic spine.

1. Wrist of first leg longer than hand. Dactylopodites of last three legs simple. (R. = $\frac{6}{1}$.)

P. orientalis Dana, 1852.

2. Wrist of first leg shorter than hand. Dactylopodites of last three legs bear a spine in the middle of the lower edge. (R. = $\frac{6}{1}$.)
P. batei n. nom.

B. A hepatic spine present.

1. Last three legs biunguiculate. Second wrist more than $\frac{1}{4}$ length of hand.

a. Second legs unequal. R. = $\frac{8}{2}$.
P. biunguiculata Nobili, 1904.

b. Second legs subequal. R. = $\frac{6-7}{3}$.
P. rathbunensis n. nom.

2. Last three legs not biunguiculate. Second wrist less than $\frac{1}{4}$ length of hand.

a. Rostrum deep, lanceolate. Palm of second leg only as long as fingers. (R. = $\frac{5-6}{1}$.)
P. amboinensis Zehnter, 1894.

b. Rostrum shallow, not lanceolate, slightly upcurved. Palm of second leg twice as long as fingers.

i. R. = $\frac{6}{1}$, lower tooth removed from tip.
P. affinis Zehnter, 1894.

ii. R. = $\frac{8-13}{2-3}$, lower teeth near tip.
P. laccadivensis Alcock and Anderson, 1894.

II. Second leg bears a spine at least on wrist, which is more than half length of hand.

A. Arm of second leg bears a spine at end. Indopacific.

1. Rostrum $\frac{3}{0}$, much shorter than antennal stalk.
P. elegans Borradaile, 1915.

2. Rostrum $\frac{6-8}{2-3}$, longer than antennal stalk.

a. Spine at end of arm of second leg subterminal. Fingers of same leg toothed. Teeth on lower side of rostrum well spaced.

i. Rostrum outreaches antennular stalk by nearly half its own length, decidedly upcurved. Wrist of first leg half as long again as hand.
P. longirostris Borradaile, 1915.

ii. Rostrum but little outreaches antennular stalk, hardly upcurved. Wrist of first leg less than half as long again as hand.
P. tridentata Borradaile, 1899.

b. Spine at end of arm of second leg terminal. Fingers of same leg not toothed. Teeth on lower side of rostrum stand close together near tip.
P. tenuipes Dana, 1852.

B. Arm of second leg bears no spine. West Indian. (R. = $\frac{7}{2}$.)
P. yucatanica Ives, 1891.

1. (Type.) *Palæmonella tenuipes* Dana, 1852.

U. S. Explor. Exped. Rep. xiii. I. p. 582; Atlas, Pl. 38, fig. 3 (1855). Stimpson, Proc. Ac. Philadelphia, 1860, p. 40. de Man, Arch. Naturg. liii. I. p. 551, Pl. 22 *a*, fig. 4 (1887). Heilprin, Proc. Ac. Philadelphia, 1888, p. 322 (?). Ortmann, Speng. Zool. Jahrb. Syst. v. p. 527 (1890). Zehnter, Rev. Suisse Zool. ii. p. 208 (1894). Nobili, Ann. Mus. Napoli, i. p. 6 (1901). Rathbun, Bull. U. S. Fish Comm. xxiii. p. 925 (1906).

? *Palæmonella tenuipes* var., Nobili, Ann. Sci. Nat. (9), iv. p. 70 (1906).

Indopacific. Bermuda ?

2. *Palæmonella orientalis* Dana, 1852.

U. S. Explor. Exped. Rep. xiii. I. p. 583; Atlas, Pl. 38, fig. 4 (1855). de Man, Arch. Naturg. liii. I. p. 552 (1887).

E. Indies, on comatulids.

3. *Palæmonella yucatanica* Ives, 1891.

Proc. Ac. Philadelphia, 1891, p. 183, Pl. 5, fig. 8.

Yucatan.

4. *Palæmonella amboinensis* Zehnter, 1894.

Rev. Suisse Zool. ii. p. 200, Pl. 9, fig. 27. de Man, Abh. Senckenb. Ges. xxv. p. 811 (1902).

E. Indies.

5. *Palæmonella affinis* Zehnter, 1894.

Rev. Suisse Zool. ii. p. 208.

Amboina, on *Actinometra*.

6. *Palæmonella laccadivensis* Alcock and Anderson, 1894.

Journ. As. Soc. Bengal, lxiii. p. 157 (1894). Illust. Zool. "Investigator," Crust. iv. Pl. 26, fig. 4 (1896). Ann. Mag. Nat. Hist. (7), iii. p. 4 (1889). Rathbun, Bull. U. S. Fish Comm. xxiii. p. 925, Pl. 22, fig. 2 (1906).

Laccadive Is. Hawaiian Is. 100—600 fms.

7. *Palæmonella tridentata* Borradaile, 1899.

Proc. Zool. Soc. Lond., 1898, p. 1007, Pl. 64, fig. 8.

Funafuti. Western Indian Ocean.

8. *Palæmonella biunguiculata* Nobili, 1904.

Bull. Mus. Paris, 1904, v. p. 233. Ann. Sci. Nat. (9), iv. p. 71, Pl. 3, fig. 6 (1906).

Jibuti.

9. *Palæmonella batei* n. nom.

Palæmonella orientalis, Bate, "Challenger" Macrura, p. 787, Pl. 128, fig. 4 (1888).

Philippine Is.

10. *Palæmonella rathbunensis* n. nom.

Palæmonella orientalis, Rathbun, Bull. U. S. Fish Comm. xxiii. p. 925 (1906).

Hawaiian Is.

11. *Palæmonella elegans* Borradaile, 1915 (Plate **53**, fig. 4).

Ann. Mag. Nat. Hist. (8), xv. p. 210.

Definition: Closely related to *P. tridentata* but with rostrum quite different, lanceolate, not reaching end of first joint of antennule, quite straight, of the formula $\frac{3}{0}$, two teeth standing behind the orbit.

Length of the single specimen, 17 mm.

Salomon.

It is possible that this is an abnormal specimen of *P. tridentata.*

12. *Palæmonella longirostris* Borradaile, 1915 (Plate **53**, fig. 5).

Ann. Mag. Nat. Hist. (8), xv. p. 210.

Definition: Related to *P. tridentata* but differs in that: (1) the rostrum is much longer, outreaching the antennular stalk by not much less than half its own length, very decidedly upcurved, and of the formula $\frac{8}{3}$, owing to the addition of a small tooth near the tip; (2) the third maxilliped is rather shorter, only reaching the end of the first joint of the antennule; (3) the wrist of the first leg is half as long again as the hand; (4) the second leg is longer and more slender, and has the arm of even width, not wider in the middle as in *P. tridentata*, the spine at the end of the arm smaller, and smaller teeth on the fingers.

Length of longest specimen, 17 mm.

Fadiffolu Atoll, Maldive Is.

Palæmonella gracilis Paulson, 1875 (Red Sea Crustacea, p. 117, Pl. 17, fig. 6) does not belong to this genus, and appears, from its telson, not to be a member of the Pontoniinæ.

Genus Periclimenes Costa, 1844.

Pelias, Roux, Mém. s. l. Salicoques, p. 25 (1831). H. M.-Edwards, Hist. Nat. Crust. ii. p. 381 (1837). Heller, Sitz. k. Ak. Wiss. Wien, xlv. p. 406 (1862); Crust. südl. Eur. p. 254 (1863).

Periclimenes, Costa, Ann. Ac. Aspir. Nat. Napoli, ii. (1844); Faun. Reg. Napoli, ii. i. (1846). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 380 (1898). Rathbun, Bull. U. S. Fish Comm. xx. ii. p. 121 (1901).

Anchistia, Dana, U. S. Explor. Exped. Rep. xiii. i. p. 577 (1852). Kingsley, Proc. Ac. Philadelphia, 1879, p. 423 (1880). Carus, Prodr. Faun. Medit. i. p. 474 (1885). Ortmann, Bronn's Thierreich, v. ii. p. 1131 (1899).

Dennisia, Norman, Ann. Mag. Nat. Hist. (3), viii. p. 278 (1861).

Definition: Body slender, usually somewhat compressed; sixth abdominal segment of moderate length; rostrum of varying shape; outer flagellum of antennule usually not deeply cleft; antennal scale of moderate breadth; mandible without palp; second maxilliped without podobranch, though often with a vestige of it, last joint mediad of preceding joint; third maxilliped slender, with small arthrobranch; legs slender, except

second pair which may be fairly heavy ; dactylopodites of last three pairs usually simple and slightly curved.

Four distinct sections may be observed in *Periclimenes*. (1) *P. aurantiaca* (Dana) differs sharply from all the rest in the lack of teeth on its rostrum. Quite possibly further information will show that it should become the type of a new genus : for the present it must have subgeneric rank. The remaining species fall into three groups. (2) In one of these the rostrum is rather short and has a convex upper edge, while the second leg is unarmed and its wrist short. In this group the supraorbital spine is rare. (3) In another group, the dorsal edge of the rostrum is convex, and the second leg of the only species in which this limb is known is short-wristed and unarmed, but the cornea, which in all other *Periclimenes* is subhemispherical, is here ogival, and a strong supraorbital spine is present. (4) The remainder of the species, including more than half the genus, form a group which is characterized by a rostrum with straight or concave upper edge and tip nearly always upturned. The second leg generally bears a spine on arm or wrist or both, and almost always has the wrist of a good length. The supraorbital spine is common in this group. The existence of certain intermediate species, such as *P. commensalis* Borradaile and *P. amethysteus* (Risso), makes it undesirable that these sections should rank as genera. I have therefore established for them four subgenera, named respectively *Ensiger*, *Cristiger*, *Corniger*, and *Falciger**. The type species of the genus belongs to *Cristiger*.

Key to the subgenera of *Periclimenes* :

I. Rostrum toothless. No spines on trunk or legs.
Ensiger Borradaile, 1915.

II. Rostrum toothed. Spines at certain points on trunk or legs.

A. Cornea ogival. [Upper edge of rostrum convex. Strong supraorbital spine.]
Corniger Borradaile, 1915.

B. Cornea not ogival.

1. Upper edge of rostrum convex. Second leg with short wrist, and unarmed, save that angles of wrist and arm are sharp in *P. gracilis*. Supraorbital spine in one species only.
Cristiger Borradaile, 1915.

2. Upper edge of rostrum straight or concave. Second leg rarely with short wrist, generally with spine on wrist or arm or both. Supraorbital spine common.
Falciger Borradaile, 1915.

Subgenus Cristiger Borradaile, 1915.

Ann. Mag. Nat. Hist. (8), xv. p. 207.

Definition : Rostrum toothed, with convex upper edge, short or of medium length. Antennal and usually hepatic spines present. Supraorbital spine very rare. Second leg

* Since these subgenera were established, in an article in the Annals and Magazine of Natural History for February, 1915, I have learned that the names of two of them (*Corniger* and *Falciger*) are preoccupied as designations of genera. They must, however, continue to stand as subgeneric names.

with short wrist, and unarmed, save that in *P. gracilis* the angles of the wrist and arm are sharp.

Key to the species of *Periclimenes* (*Cristiger*):

I. Rostrum much shorter than antennular stalk. Second leg shorter than first. [R. = $\frac{5}{0}$, lanceolate, two teeth behind orbit.]

P. (*C.*) *brevinaris* Nobili, 1905.

II. Rostrum little if at all shorter than antennular stalk. Second leg longer than first.

A. Three or four rostral teeth behind orbit. Three teeth below rostrum. Atlantic and Mediterranean.

1. Rostrum deep, horizontal. Second leg outreaches antennal scale by hand only. European. [R. = $\frac{8-9}{3}$.]

P. (*C.*) *scriptus* (Risso), 1826.

2. Rostrum shallow, bent downwards. Second leg outreaches antennal scale by wrist and hand. W. Atlantic. [R. = $\frac{2}{3}$.]

P. (*C.*) *tenellus* (Smith), 1882.

B. No rostral tooth behind orbit. Very rarely more than one tooth below rostrum*. Indopacific.

1. Rostrum lanceolate.

a. Dorsal edge of rostrum bears nine or more teeth.

i. Antepenultimate joint of third maxilliped broad. R. = $\frac{9-10}{1}$. Fingers of first leg not denticulate.

P. (*C.*) *brocki* (de Man), 1887.

ii. Antepenultimate joint of third maxilliped narrow. R. = $\frac{11-13}{0}$. Fingers of first leg denticulate.

α. First joint of antennule bears two distal spines. No accessory spinule on dactylopodites of last three legs.

P. (*C.*) *frater* Borradaile, 1915.

β. First joint of antennule bears one distal spine. An accessory spinule on dactylopodites of last three legs.

P. (*C.*) *soror* Nobili, 1904.

b. Dorsal edge of rostrum bears seven or fewer teeth.

i. Ventral edge of rostrum bears more than one tooth.

a. A supraorbital spine. [R. = $\frac{5}{2}$.]

P. (*C.*) *commensalis* Borradaile, 1915.

* Only *P. notatus* has three.

β. No supraorbital spine.

(1) R. = $\frac{7}{3}$. Hepatic spine present. Antennal scale bears distal spine at end.

P. (*C.*) *notatus* (Heller), 1865.

(2) R. = $\frac{6}{2}$. Hepatic spine absent. Antennal scale bears distal spine at a little distance from end.

P. (*C.*) *pusillus* Rathbun, 1903.

ii. Ventral edge of rostrum bears one tooth.

α. Rostrum $\frac{5-6}{1}$; longer than antennular stalk; its tip not upturned. Angles of arm and wrist sharp.

P. (*C.*) *gracilis* (Dana), 1852.

β. Rostrum $\frac{5}{1}$; shorter than antennular stalk; its tip a little upturned. Angles of arm and wrist not sharp.

P. (*C.*) *potina* Nobili, 1905.

2. Rostrum not lanceolate, with decided reversal of curve at tip.

a. Rostrum $\frac{6}{1}$; outreaching antennular stalk. Hepatic spine present. Hand of second leg elongate.

i. A denticle on carapace behind rostral crest. Last joint of third maxilliped slightly shorter than penultimate.

P. (*C.*) *incertus* Borradaile, 1915.

ii. No denticle on carapace behind rostral crest. Last joint of third maxilliped slightly longer than penultimate.

P. (*C.*) *parvus* Borradaile, 1898.

b. Rostrum $\frac{7}{0}$; outreached by antennular stalk. No hepatic spine. Hand of second leg short.

P. (*C.*) *parasiticus* Borradaile, 1898.

1. (Type.) *Periclimenes* (*Cristiger*) *scriptus* (Risso), 1826.

Alpheus scriptus, Risso, Hist. Nat. Eur. Mér. v. p. 78 (1826); Acad. Leop., 1826, p. 821.

Pelias scriptus, Roux, Mém. s. l. Salicoques, p. 25 (1831). Heller, Sitz. k. Ak. Wiss. Wien, Math.-Nat. Cl. xlv. p. 406, Pl. 2, fig. 34 (1862).

Periclimenes insignis, Costa, Ann. Ac. Aspir. Nat. Napoli, ii. (1844); Faun. Regn. Napoli, ii. 1. Pl. 6, figs. 1—6 (1846).

Dennisia sagittifera, Norman, Ann. Mag. Nat. Hist. (3), viii. p. 278, Pl. 13, figs. 8—13 (1861).

Anchistia scripta, Heller, Crust. südl. Eur. p. 256, Pl. 8, figs. 18, 19 (1863). Carus, Prodr. Faun. Medit. i. p. 476 (1885).

Periclimenes scriptus, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 381 (1898).

Mediterranean, Guernsey. To 30 fms.

2. *Periclimenes* (*Cristiger*) *gracilis* (Dana), 1852.

Anchistia gracilis, Dana, U. S. Explor. Exped. xiii. i. p. 578 (1852); Atlas, Pl. 37, fig. 5 (1855).
Periclimenes gracilis, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 381 (1898).
Sulu Sea.

3. *Periclimenes* (*Cristiger*) *notatus* (Heller), 1865.

Anchistia notata, Heller, "Novara" Rep., Zool. ii. iii. p. 109, Pl. 10, fig. 3 (1865).
Periclimenes notatus, Borradaile, Ann. Mag. Nat. Hist. (7), iii. p. 382 (1898).
Nicobar Is.

4. *Periclimenes* (*Cristiger*) *tenellus* (S. J. Smith), 1882.

Anchistia tenella, S. J. Smith, Bull. Mus. Harvard, x. p. 55, Pl. 9, fig. 1 (1882).
Periclimenes tenellus, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 383 (1898).
E. coast of N. America, 229 fms.

5. *Periclimenes* (*Cristiger*) *brocki* (de Man), 1887 (Plates **53**, **54**, figs. 8*f*—*i*).

Anchistia Brockii, de Man, Arch. Naturg. liii. i. p. 548, Pl. 22 *a*, fig. 3 (1887).
Periclimenes Brocki, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 383 (1898).
Amboina. Maldive Is., to 43 fms., on sea urchin.

6. *Periclimenes* (*Cristiger*) *parvus* Borradaile, 1898.

Periclimenes parvus, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 384 (1898); Willey's Zool. Results, iv. p. 407, Pl. 1, fig. 3 (1899).
New Britain.

7. *Periclimenes* (*Cristiger*) *parasiticus* Borradaile, 1898.

Periclimenes parasiticus, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 384 (1898); Willey's Zool. Results, iv. p. 407, Pl. 1, fig. 4 (1899).
New Britain, on *Linckia*.

8. *Periclimenes* (*Cristiger*) *pusillus* Rathbun, 1903.

Periclimenes pusillus, Rathbun, Bull. U. S. Fish Comm. xxiii. iii. p. 921, fig. 71, Pl. 24. fig. 7 (1903).
Hawaiian Is.

9. *Periclimenes* (*Cristiger*) *soror* Nobili, 1904.

Periclimenes soror, Nobili, Bull. Mus. Paris, 1904, v. p. 231; Ann. Sci. Nat. (9), iv. p. 50, Pl. 2, fig. 6 (1906).
Jibuti.

10. *Periclimenes potina* Nobili, 1905.

Periclimenes potina, Nobili, Bull. Mus. Paris, 1905, p. 159; Bull. Sci. Tr. Belg. xl. p. 44, Pl. 3, fig. 8 (1906).
Persian Gulf, on floating brown seaweed.

11. *Periclimenes* (*Cristiger*) *brevinaris* Nobili, 1905.

Periclimenes Borradailei, Nobili, Bull. Mus. Paris, 1905, iii. p. 159.

Periclimenes brevinaris, Nobili, Bull. Sci. Tr. Belg. xl. p. 42, Pl. 3, fig. 7 (1906).

Persian Gulf.

12. *Periclimenes* (*Cristiger*) *frater* Borradaile, 1915 (Plate **53**, fig. 6).

Ann. Mag. Nat. Hist. (8), xv. p. 210.

Definition: Closely related to *P. soror*, but differing from it in that (1) the teeth on the upper edge of the rostrum are closer set towards the tip than near the base, (2) there are *two* distal spines on the first joint of the antennule, (3) the antennal scale decidedly outreaches the first leg, (4) there is no accessory denticle on the dactylopodites of the last three legs.

Length of the longer of the two specimens, 13 mm.

Seychelles, on reef.

13. *Periclimenes* (*Cristiger*) *incertus* Borradaile, 1915 (Plate **53**, fig. 7).

Ann. Mag. Nat. Hist. (8), xv. p. 210.

Definition: Closely related to *P. parvus*, but differing from it in that (1) the body is more slender, (2) the rostrum is shallower, (3) there is a denticle on the carapace behind the beginning of the rostral crest, (4) the third maxilliped is rather longer, owing to the greater length of the penultimate joint, which is considerably longer than the end joint.

Length of the single specimen, 11 mm.

Maldive Is.

The specific distinctness of this form from *P. parvus* is somewhat doubtful.

14. *Periclimenes* (*Cristiger*) *commensalis* Borradaile, 1915.

Ann. Mag. Nat. Hist. (8), xv. p. 211. Potts, Pap. Dep. Mar. Biol. Carnegie Inst. Washington, viii. p. 82 (1915).

Definition: Body rather stout, not compressed; rostrum reaching end of antennular stalk, outreached by antennal scale, lanceolate, directed slightly downwards, its formula $\frac{5}{2}$; supraorbital, hepatic, and antennal spines present; cornea subhemispherical; first joint of antennular stalk broad, with moderate stylocerite and two distal spines, second and third joints subequal, together shorter than first joint, flagella of a fair length, the outer rather deeply cleft; antenna with small basal spine, stalk nearly reaching end of first joint of antennule, scale wide, with straight outer and convex inner side, and distal spine of good size but not reaching end; third maxilliped slender, reaching end of antennal stalk, its long joint a good deal curved; first leg reaching end of thicker division of outer antennular flagellum, arm and wrist equal, hand shorter, fingers a little longer than palm; second leg short, unarmed, its wrist subconical, hand nearly equal to three preceding joints together, fingers equal to palm, not gaping, each with three small teeth near base; last three legs short, hairy, with a spine above and one below end claw of short, rather stout dactylopodite; telson shorter than uropods.

Torres Straits, on *Comanthus annulatus*.

Subgenus Corniger Borradaile, 1915.

Ann. Mag. Nat. Hist. (8), xv. p. 207.

Definition: Rostrum toothed, but without teeth behind orbit; its upper edge convex, but sometimes only slightly so. Antennal, hepatic, and strong supraorbital spines present. Eye ogival. Second leg at present only known in one species, where it is unarmed and has short wrist.

Key to the species of *Periclimenes* (*Corniger*):

I. Rostrum lanceolate, outreached by antennular stalk.

A. Rostrum deep, $\frac{7}{1}$. Eye without papilla.
P. (*C.*) *cornutus* Borradaile, 1915.

B. Rostrum shallow, $\frac{4}{0}$. Eye with papilla at apex.
P. (*C.*) *ceratophthalmus* Borradaile, 1915.

II. Rostrum with upper edge but slightly convex and lower edge straight till within short distance of tip, which is slightly upturned. Antennular stalk outreached by rostrum. [R. = $\frac{6}{1}$.]
P. (*C.*) *amboinensis* (de Man), 1887.

1. (Type.) *Periclimenes* (*Corniger*) *ceratophthalmus* Borradaile, 1915 (Plate **54**, fig. 9).

Ann. Mag. Nat. Hist. (8), xv. p. 211.

Definition: Body not much compressed; rostrum outreached barely by antennular stalk but distinctly by antennal scale, straight, shallow, lanceolate, bearing above four teeth, all in its distal half, and no teeth below; eye ogival, ending in a papilla; supraorbital, antennal and hepatic spines present; first joint of antennular stalk not greatly expanded, with moderate stylocerite, second and third joints stout and subequal, flagella short; antennal stalk about $\frac{3}{4}$ length of first joint of antennule, scale broad, with small distal tooth set well back from end; third maxilliped short, rather stout; first leg outreaching antennal scale by its fingers, its arm and wrist subequal, hand about half length of wrist; second leg outreaching antennal scale by nearly the whole of its hand, stout, with short wrist and no spines on any joint, hand flattened, parallel-sided, with fingers simple and about $\frac{2}{3}$ length of hand; telson considerably shorter than uropods.

Length of the single specimen, 8 mm.

Malé Atoll, Maldive Is., on crinoid, with polychæte.

2. *Periclimenes* (*Corniger*) *cornutus* Borradaile, 1915 (Plate **54**, fig. 10).

Ann. Mag. Nat. Hist. (8), xv. p. 211.

Definition: Body moderately compressed; rostrum outreached slightly by antennular stalk and rather more by antennal scale, lanceolate, deep, bearing above seven teeth, none behind orbit, and one tooth below; antennal, hepatic close behind antennal, and strong, compressed supraorbital spines present; cornea ogival; first joint of antennule

well expanded, with moderate stylocerite and distal spine, second and third joints stout and subequal; antennal scale of moderate breadth, almost straight-sided, its end truncate and not reached by its distal spine; third maxilliped slightly outreaching antennal stalk, but not reaching end of first joint of antennular stalk; first leg outreaching antennal scale by hand, its wrist and arm equal, hand shorter than wrist, palm and fingers subequal; last three legs stout, their propodites hairy and armed with spines, their dactylopodites gently curved and ending in a sharp claw; telson shorter than uropods, diminishing rather suddenly near the end, which is rounded and has all the spines short.

Length of the single specimen 12 mm.

Malé Atoll, Maldive Is., on red and brown crinoid.

3. *Periclimenes* (*Corniger*) *amboinensis* (de Man), 1887.

Anchistia amboinensis, de Man, Arch. Naturg. liii. 1. p. 546, Pl. 22 *a*, fig. 2 (1887).
Periclimenes amboinensis, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 383 (1898).
Amboina.

Subgenus Falciger Borradaile, 1915.

Ann. Mag. Nat. Hist. (8), xv. p. 207.

Definition: Rostrum toothed, with straight or concave upper edge, nearly always upcurved at tip, long or of medium length. Antennal, usually hepatic, and often supraorbital spines present. Second leg usually with wrist long or of moderate length, usually with spine at end of wrist or arm or both.

Key to the species of *Periclimenes* (*Falciger*).

I. Fingers of great chela each with an oval pit; those of first legs with comb-like arrangement of fine teeth. [R. = $\frac{7}{3-5}$.]

A. Supraorbital spine present.

P. (*F.*) *spiniferus* de Man, 1902.

B. Supraorbital spine absent.

P. (*F.*) *petitthouarsi* (Audouin), 1825.

II. Fingers of great chela, and usually also those of first legs, not as in I.

A. Supraorbital spine present.

1. Rostrum without teeth below. [R. = $\frac{6}{0}$.]

P. (*F.*) *lifuensis* Borradaile, 1898.

2. Rostrum with teeth below.

a. Second leg unarmed. Antennal scale broad; with distal spine not projecting beyond end.

i. Antennular stalk reaches end of rostrum. Teeth above rostrum show a gap in middle of series. [R = $\frac{7}{3}$.]

P. (*F.*) *edwardsi* (Paulson), 1875.

ii. Antennular stalk does not reach end of rostrum. Teeth above rostrum show no gap in middle of series. [R.=$\frac{2}{4}$.]
P. (*F.*) *nilandensis* Borradaile, 1915.

b. Second leg bears one or more spines. Antennal scale narrow; with distal spine projecting beyond end.

i. Upper edge of rostrum straight at first, upcurved at end.

a. Rostrum shallow, little excavated at base, not reaching end of antennular stalk. Second wrist bears one spine.

(1) Antennal scale broad. Second wrist more than half length of hand. [R.=$\frac{7}{2-3}$.]
P. (*F.*) *danæ* (Stimpson), 1860.

(2) Antennal scale narrow. Second wrist about one-third length of hand. [R=$\frac{7}{?}$.]
P. (*F.*) *grandis* (Stimpson), 1860.

β. Rostrum deep, much excavate at base. Second wrist bears two or three spines.

(1) Outer edge of antepenultimate joint of third maxilliped bears one spine. Wrist of second leg has no spine on the inner side. Fingers of same leg toothless. [R.=$\frac{7}{3}$.]
P. (*F.*) *elegans* (Paulson), 1875.

(2) Outer edge of antepenultimate joint of third maxilliped bears several spines. Wrist of second leg has strong spine on inner side. Fingers of same leg toothed.

(*a*) R.=$\frac{7}{2}$; its tip simple. In second leg fingers about one-third length of palm, and wrist nearly twice length of fingers.
P. (*F.*) *affinis* Borradaile, 1915.

(*b*) R.=$\frac{8}{4}$; its tip bifid. In second leg fingers rather more than half length of palm, and wrist equal in length to fingers.
P. (*F.*) *dubius* Borradaile, 1915.

ii. Upper edge of rostrum concave from base.

a. Rostrum deep. Second wrist about as long as arm.

(1) Antennule has flagella shorter than stalk and third joint longer than second. Not more than one spine at end of second wrist.

(*a*) Second wrist without spine; a little longer than arm. [R=$\frac{6-7}{2-3}$.]
P. (*F.*) *ensifrons* (Dana), 1852.

(*β*) Second wrist bears a spine; a little shorter than arm. [R=$\frac{6-8}{3-4}$.]
P. (*F.*) *vitiensis* Borradaile, 1898.

(2) Antennule has flagella longer than stalk and third joint subequal to second. Two spines at end of second wrist.
P. (*F.*) *holmesi* Nobili, 1907.

β. Rostrum shallow. Second wrist not nearly as long as arm. [R. = $\frac{8}{3}$.]
P. (*F.*) *amymone* de Man, 1902.

B. No supraorbital spine.

1. Upper edge of rostrum straight at first, though its tip may be upturned.

a. Rostrum without teeth below. Last two joints of antennular stalk very long. [R = $\frac{6}{0}$.]
P. (*F.*) *longimanus* (Dana), 1852.

b. Rostrum with one or more teeth below. Last two joints of antennular stalk usually short.

i. Second leg unarmed.

α. Rostrum of good depth. Second wrist long. [R. = $\frac{7-9}{2-3}$.]
P. (*F.*) *americanus* (Kingsley), 1878.

β. Rostrum rather shallow. Second wrist short.

(1) Rostrum has three teeth below, and two behind orbit, and is directed straight forwards.

(*a*) R. = $\frac{5}{3}$ with additional denticle at tip. First and second legs outreach antennal scale.
P. (*F.*) *compressus* Borradaile, 1915.

(*b*) R. = $\frac{8}{3}$. First and second legs do not outreach antennal scale.
P. (*F.*) *amethysteus* (Risso), 1826.

(2) Rostrum has one tooth below, and one behind orbit, and is directed somewhat downwards. [R. = $\frac{6}{1}$.]
P. (*F.*) *brocketti* Borradaile, 1915.

ii. Second leg bears one or more spines.

α. Second wrist bears three spines. One rostral tooth behind orbit.

(1) Second arm bears four spines. Antennal scale of good breadth. [R. = $\frac{7}{3}$.]
P. (*F.*) *denticulatus* Nobili, 1907.

(2) Second arm bears one spine. Antennal scale narrow.
P. (*F.*) *brachiatus* (Stimpson), 1860.

β. Second wrist bears one spine. Two rostral teeth behind orbit.

(1) Antennal scale broad, not outcurved, its distal spine not projecting beyond its end. Rostrum not outreaching antennular stalk. [R. = $\frac{6}{2}$.]
P. (*F.*) *rotumanus* Borradaile, 1898.

(2) Antennal scale narrow, outcurved, its distal spine projecting beyond its end. Rostrum outreaching antennular stalk.

(*a*) Antennal scale shorter than carapace. Last two joints of antennular stalk slender. [R. = $\frac{6-7}{2}$.]

P. (*F.*) *suvadivensis* Borradaile, 1915.

(*b*) Antennal scale longer than carapace. Last two joints of antennular stalk stout. [R. = $\frac{7}{2}$.]

P. (*F.*) *pottsi* Borradaile, 1915.

2. Upper edge of rostrum decidedly concave from base.

a. Rostrum deep, $\frac{7-8}{3}$. Second leg unarmed.

P. (*F.*) *seychellensis* Borradaile, 1915.

b. Rostrum slender, $\frac{10}{7}$. Second leg bears spines on arm and wrist.

i. Rostrum not more than $1\frac{3}{4}$ times length of carapace. Second legs not more than five times length of carapace.

P. (*F.*) *borradailei* Rathbun, 1904.

ii. Rostrum $2\frac{1}{2}$ times length of carapace. Second legs seven times length of carapace.

P. (*F.*) *kolumadulensis* Borradaile, 1915.

1. (Type). *Periclimenes* (*Falciger*) *spiniferus* de Man, 1902 (Plate **52**, fig. 1).

Anchistia inæquimana, Heller, "Novara" Rep., Zool. ii. III. p. 109 (1865).

Anchistia Petitthouarsii, de Man, Arch. Naturg. liii. I. p. 54 (1887).

Periclimenes petitthouarsii var. *spinifera*, de Man, Abh. Senckenb. Ges. xxv. III. p. 824 (1902).

Periclimenes Petitthouarsii var. *spinigera*, Nobili, Ann. Sci. Nat. Zool. (9), iv. p. 49 (1906).

Periclimenes Petitthouarsi var. *spinifera*, Lenz, Voeltzkow's Reise in Ostafrika, ii. p. 567 (1910).

Tahiti. E. Indies. Indian Ocean.

2. *Periclimenes* (*Falciger*) *petitthouarsi* (Audouin), 1825.

Palæmon Petitthouarsii, Audouin, Descr. Egypte, Hist. Nat. i. IV. p. 91 (1825). Savigny, Atlas, Crust. pl. 10, fig. 3.

Anchistia inæquimana, Heller, Sitz. k. Ak. Wiss. Wien, xliv. I. p. 283 (1861).

Anchistia Petitthouarsii, Kossmann, Ergebn. Reise Rot. Meeres, p. 83 (1880).

Periclimenes Petitthouarsi, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 381 (1898). Nobili, Ann. Mus. Univ. Napoli, i. III. p. 6 (1901); Bull. Sci. Fr. Belg. xl. p. 41 (1906). Lenz, Ark. Zool. vii. XXIX. p. 2 (1912).

Periclimenes petitthouarsii, typischen art, de Man, Abh. Senckenb. Ges. xxv. III. p. 824 (1902).

Periclimenes Petitthouarsii, forme typique, Nobili, Ann. Sci. Nat., Zool. (9), iv. p. 49 (1906).

Red Sea. Persian Gulf.

3. *Periclimenes* (*Falciger*) *amethysteus* (Risso), 1826.

Alpheus amethysteus, Risso, Hist. Nat. Eur. Mér. v. p. 77, Pl. 4, fig. 16 (1826); Acad. Leop., 1826, p. 821.

Pelias amethysteus, Roux, Mém. s. l. Salicoques, p. 25 (1831). Heller, Sitz. k. Ak. Wiss. Wien, Math.-Nat. Cl. xlv. i. p. 408 (1863).

Anchistia amethystea, Heller, Crust. südl. Eur. pp. 256, 258 (1863). Carus, Prodr. Faun. Medit. i. p. 476 (1885).

Periclimenes amethysteus, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 381 (1895).

Mediterranean.

4. *Periclimenes* (*Falciger*) *longimanus* (Dana), 1852.

Anchistia longimana, Dana, U. S. Explor. Exped. Rep. xiii. i. p. 579 (1852); Atlas, Pl. 37, fig. 6 (1855).

Periclimenes longimanus, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 381 (1898).

Loc. ?

5. *Periclimenes* (*Falciger*) *ensifrons* (Dana), 1852.

Anchistia ensifrons, Dana, U. S. Explor. Exped. Rep. xiii. i. p. 580 (1852); Atlas, Pl. 38, fig. 1 (1855). Müller, Verh. nat. Ges. Basel, viii. i. p. 471 (1887). Ortmann, Jena. Denkschr. viii. p. 16 (1894).

Periclimenes ensifrons, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 382 (1898). Nobili, Mem. Ac. Torino (2), lvii. p. 350 (1907).

Indopacific.

6. *Periclimenes* (*Falciger*) *grandis* (Stimpson), 1860.

Anchistia grandis, Stimpson, Proc. Ac. Philadelphia, 1860, p. 39.

Periclimenes grandis, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 382 (1898). Balss, Abh. k. Bayer. Ak. Wiss., Math.-Phys. Kl. ii. Suppl. Bd. x. p. 49 (1914).

? *Anchistia Petitthouarsi*, Miers, "Alert" Report, Crust. p. 293 (1884).

Ousima I. Port Molle?

7. *Periclimenes* (*Falciger*) *brachiatus* (Stimpson), 1860.

Anchistia brachiata, Stimpson, Proc. Ac. Philadelphia, 1860, p. 39.

Periclimenes brachiatus, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 382 (1898). Balss, Abh. k. Bayer. Ak. Wiss., Math.-Phys. Kl. ii. Suppl. Bd. x. p. 49 (1914).

Bonin Is.

8. *Periclimenes* (*Falciger*) *danæ* (Stimpson), 1860.

Anchistia Danæ, Stimpson, Proc. Ac. Philadelphia, 1880, p. 39.

Periclimenes Danæ, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 382 (1898).

Periclimenes danæ (?), Borradaile, Proc. Zool. Soc. Lond. 1898, p. 1004, Pl. 63, fig. 4 (1899).

Tahiti. Ellice Is., on coral reef.

9. *Periclimenes* (*Falciger*) *edwardsi* (Paulson), 1875.

Anchistia Edwardsi, Paulson, Crust. Red Sea, i. p. 114, Pl. 17, fig. 2 (1875). Nobili, Ann. Sci. Nat., Zool. (7) iv. p. 53 (1906).

Red Sea.

10. *Periclimenes* (*Falciger*) *elegans* (Paulson), 1875.

Anchistia elegans, Paulson, Crust. Red Sea, i. p. 113, Pl. 17, fig. 1 (1875). Nobili, Ann. Sci. Nat., Zool. (9), iv. p. 52 (1906).

Red Sea.

11. *Periclimenes* (*Falciger*) *americanus* (Kingsley), 1878.

Anchistia americana, Kingsley, Proc. Ac. Philadelphia, 1878, p. 96; Bull. Essex Inst. xiv. p. 109, Pl. 2, fig. 10 (1882).

Periclimenes americanus, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 383 (1898). Rathbun, Bull. U. S. Fish Comm. xx. II. p. 121 (1901).

Mid-west Atlantic. To 34 fms.

12. *Periclimenes* (*Falciger*) *rotumanus* Borradaile, 1898.

Periclimenes rotumanus, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 383 (1898); Proc. Zool. Soc. Lond., 1898, p. 1005, Pl. 63, fig. 5 (1899).

Rotuma.

13. *Periclimenes* (*Falciger*) *vitiensis* Borradaile, (1898).

Anchistia ensifrons, de Man, Arch. Naturg. liii. I. p. 545 (1887). Ortmann, Jena. Denkschr. viii. p. 16 (1894).

Periclimenes vitiensis, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 383 (1898). Proc. Zool. Soc. Lond., 1898, p. 1005, Pl. 64, fig. 6 (1899). Pearson, Rep. Ceylon Pearl Fish. iv. p. 78 (1905).

Periclimenes ensifrons, de Man, Abh. Senckenb. Ges. xxv. III. p. 126 (1902). Lenz, Abh. Senckenb. Ges. xxvii. IV. p. 380 (1905).

Indopacific.

The supposed spine at the end of the wrist of the *first* leg in this species is an appearance due to a bundle of long hairs. The spine at the end of the *second* wrist is found in both sexes and serves, together with the comparative shortness of this wrist and the greater average number of teeth on the rostrum, to distinguish *P. vitiensis* from *P. ensifrons*. The collection described by Ortmann contained members of both species.

14. *Periclimenes* (*Falciger*) *lifuensis* Borradaile, 1898.

Periclimenes lifuensis, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 384 (1898); Willey's Zool. Results, iv. p. 405, Pl. 36, fig. 1 (1899).

Loyalty Is.

15. *Periclimenes* (*Falciger*) *amymone* de Man, 1902.

Periclimenes amymone, de Man, Abh. Senckenb. Ges. xxv. III. p. 829, Pl. 25, fig. 53 (1902).

Ternate.

16. *Periclimenes* (*Falciger*) *borradailei* Rathbun, 1904.

Periclimenes tenuipes, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 384 (1898); Willey's Zool. Results, iv. p. 406, Pl. 36, fig. 2 (1899).

Periclimenes borradailei, Rathbun, Dec. Crust. N.W. America, p. 34 (1904). Nobili, Ann. Mus. Univ. Napoli, ii. xxi. p. 5 (1907).

New Britain, on coral reef.

17. *Periclimenes* (*Falciger*) *holmesi* Nobili, 1907.

Anchistia tenuipes, Holmes, Occ. Pap. Calif. Ac. Sci. vii. p. 216 (1900).

Periclimenes holmesi, Nobili, Ann. Mus. Univ. Napoli, ii. xxi. p. 5 (1907).

Santa Catalina I.

18. *Periclimenes* (*Falciger*) *denticulatus* Nobili, 1907.

Periclimenes Petitthouarsii var. *denticulata*, Nobili, Mem. Ac. Torino, (2), lvii. p. 359 (1907).

Polynesia.

19. *Periclimenes* (*Falciger*) *nilandensis* Borradaile, 1915 (Plate **54**, fig. 13).

Ann. Mag. Nat. Hist. (8), xv. p. 211.

Definition: Body moderately slender and compressed: rostrum distinctly outreaching antennular stalk but barely antennal scale, its upper edge gently concave from base, its formula $\frac{2}{4}$; supraorbital, antennal and hepatic spines present; antennular stalk slender, its basal joint not much expanded, second joint longer than third, flagella nearly twice as long as stalk, delicate; antennal scale moderately broad, with rounded end, its distal spine not reaching the end, its fringe very long; first leg with wrist and arm equal, hand slightly shorter than either, fingers equal to palm; second legs unequal, the longer outreaching antennal scale by wrist and hand, arm and palm subequal, wrist a little shorter than either, fingers about two-thirds length of palm, simple, all joints unarmed; last three legs slender, with simple, nearly straight dactylopodites, and a row of six spines under propodite.

Length of the single specimen, 16 mm.

S. Nilandu Atoll, Maldive Is.

20. *Periclimenes* (*Falciger*) *affinis* Borradaile, 1915 (Plate **54**, fig. 11).

Ann. Mag. Nat. Hist. (8), xv. p. 211.

Definition: Body graceful; rostrum of medium depth, straight for the first two-thirds of its length, gently upcurved at the tip, its formula $\frac{7}{2}$, the first two teeth standing behind the orbit, the last at a little distance from the tip, the first and last somewhat apart from the rest; antennular stalk ending between sixth and seventh rostral teeth, its last joint a little longer than its second joint; antennal scale slender, tapering, slightly outcurved, reaching end of rostrum; third maxilliped not quite reaching end of second joint of antennule, bearing several spines on outer edge of long joint; first leg just reaching end of wrist of second, with wrist about $1\frac{1}{2}$ times length of hand; second

leg outreaching rostrum by wrist and hand, its arm and wrist subequal, fingers about two-thirds length of wrist, palm a little longer than wrist, all joints smooth; arm bearing at end a spine below, and wrist a spine above, a similar spine inside, and a blunt tooth below, fingers straight, bent slightly inwards from axis of palm, and armed with two or three interlocking teeth; last three legs slender, with a few spinules on underside of propodites, and dactylopodites long and nearly straight; telson pointed, with naked submedian spines.

Length of longer of the two specimens, 11 mm.

Salomon I., Western Indian Ocean.

21. *Periclimenes* (*Falciger*) *dubius* Borradaile, 1915 (Plate **54**, fig. 12).

Ann. Mag. Nat. Hist. (8) xv. p. 211.

Definition: Closely related to *P. affinis*, but differing in that (1) the rostral formula is $\frac{8}{4}$, (2) the tip of the rostrum is bifid, (3) the stalk of the antennule is shorter and stouter, (4) in the second leg the arm and wrist are stouter, while the fingers are rather more than half the length of the palm and about equal in length to the wrist, (5) the end of the telson bears a few bristles besides the ordinary spines.

Length of the single specimen, 22 mm.

Minikoi.

P. elegans, *P. affinis*, and *P. dubius* are very closely related species and may eventually prove not to be distinct.

22. *Periclimenes* (*Falciger*) *compressus* Borradaile, 1915 (Plate **55**, fig. 18).

Ann. Mag. Nat. Hist. (8), xv. p. 212.

Definition: Body a good deal compressed; rostrum outreaching antennal scale very little, and antennular stalk rather more, deepest at its base, diminishing evenly towards tip which is slightly upturned, bearing above five teeth, of which two stand behind the orbit, and a minute vestigial tooth near the tip, and below three teeth; antennal and hepatic spines present; first joint of antennular stalk well expanded, with strong distal spines, second and third joints subequal, subcylindrical, together shorter than first joint; antennal scale narrow, with sides parallel, tip rounded, and distal spine not reaching tip, antennal stalk not reaching end of first joint of antennule; third maxilliped not reaching end of antennal stalk; first leg outreaching antennal scale by more than half the hand, its wrist, palm, and fingers subequal; second legs equal and similar, outreaching antennal scale by hand, wrists short and subconical, with a notch on the inner side, hands long, parallel-sided, somewhat compressed, fingers less than half length of palm, a small tooth near the base of each moveable finger, and two or three vestigial teeth on the fixed finger; last three legs long, slender, without spines, and with long, sharp, simple dactylopodites; telson little shorter than uropods, long, and truncate.

Length of single specimen, 24 mm.

Saya de Malha.

23. *Periclimenes* (*Falciger*) *brocketti* Borradaile, 1915 (Plate **55**, fig. 15).

Ann. Mag. Nat. Hist. (8), xv. p. 212.

Definition: Body moderately compressed; rostrum not quite reaching end of antennal scale, but outreaching antennular stalk, shallow, directed slightly downwards, straight, save for a very slight upcurving of the tip, bearing above six teeth, of which one stands immediately behind the orbit, and below one tooth; antennal and hepatic spines present; first joint of antennular stalk moderately expanded, with stylocerite half as long as the joint, and two small distal spines, second joint wide, shorter than third joint; stalk of antenna a good deal shorter than first joint of antennular stalk, scale of antenna rather broad, with pointed end and small distal spine which does not nearly reach the end; third maxilliped not reaching end of antennal stalk, its long joint rather broad; first leg slightly outreaching antennal scale, with wrist a little shorter than arm, hand shorter than wrist, fingers longer than palm, hairy; second leg outreaching antennal scale by its hand and greater part of wrist, which is comparatively short, hand slender, fingers simple, about as long as palm; last three legs with propodites unarmed and dactylopodites small, slender, and set in a tuft of hairs; telson narrow, a good deal shorter than uropods.

Length of the longest of the three specimens, 16 mm.

Malé Atoll, Maldive Is., on brown crinoid.

I have called this species after Mr W. Brockett, Head Attendant in the Cambridge University Laboratory of Zoology, to whose skilled and ready assistance all Cambridge zoologists are greatly indebted.

24. *Periclimenes* (*Falciger*) *pottsi* Borradaile, 1915.

Ann. Mag. Nat. Hist. (8) xv. p. 213. Potts, Pap. Dep. Mar. Biol. Carnegie Inst. Washington, viii. p. 82 (1918).

Definition: Body moderately stout, somewhat compressed; rostrum reaching end of antennal scale, outreaching antennular stalk, its upper edge curving very slightly downward from the base and more strongly upward near the tip, its formula $\frac{7}{2}$, two teeth behind the orbit; hepatic and antennal spines present; basal joint of antennule elongate, with small distal spine, second and third joints stout, subequal, flagella about twice length of stalk, outer not deeply cleft; antennal scale shorter than carapace, rather narrow, outcurved, its distal spine projecting beyond its end; antennal stalk falling considerably short of end of first joint of antennular; third maxilliped outreaching by its last joint antennal stalk, slender, nearly straight, its last two joints together longer than preceding joint; first leg outreaching antennal scale by its hand, its arm and wrist subequal, hand nearly as long, and fingers slightly longer than palm; second leg outreaching antennal scale by hand and part of wrist, with arm a little longer than wrist, palm than arm, fingers and wrist subequal, a spine at end of arm and a small spine above at end of wrist; last three legs slender, sparsely hairy, with small spinules under propodites, and rather slender, slightly curved dactylopodites.

Colour, purple, brownish in parts and varying in depth with the region of the body.

Length of longest specimen 13 mm.

Torres Straits, on *Comanthus*.

25. *Periclimenes* (*Falciger*) *suvadivensis* Borradaile, 1915 (Plate **55**, fig. 16).

Ann. Mag. Nat. Hist. (8), xv. p. 212.

Definition: Body rather slender and compressed; rostrum outreaching antennular stalk, outreached by antennal scale, straight, except at the end, which is gently upcurved, diminishing evenly to its end, with formula $\frac{6-7}{2}$, two of the teeth standing behind the orbit; hepatic, antennal, and suborbital spines present; antennule slender throughout; its second and third joints equal, its first joint equal to the second and third together, its outer flagellum long and only cleft near the tip; antennal scale longer than carapace, narrow, outcurved, its distal spine projecting at the end; third maxilliped reaching end of first joint of antennule; first leg outreaching antennular stalk by wrist and hand, arm shorter than wrist, hand about half as long as wrist, fingers slightly longer than palm; second leg outreaching antennal scale by hand, wrist, and small part of arm, its wrist bearing at the end a short stout spine above, its arm a small spine below, wrist and palm subequal, fingers rather more than half the length of palm, simply toothed; last three legs very long and slender, outreaching antennal scale, bearing a few stout hairs, their dactylopodites simple, slender, and nearly straight; uropods considerably outreaching telson.

Length of the longest of the two specimens, 14 mm.

Suvadiva Atoll, Maldive Is.

26. *Periclimenes* (*Falciger*) *seychellensis* Borradaile, 1915 (Plates **54**, **55**, figs. 14 *a*—*i*).

Ann. Mag. Nat. Hist. (8), xv. p. 212.

Definition: Body moderately stout, not much compressed; rostrum outreaching antennular stalk, and antennal scale, deep, its ventral edge excavate at base, its dorsal edge concave throughout, its formula $\frac{7-8}{3}$, with two teeth behind the orbit; antennal and hepatic spines present; first joint of antennular stalk moderately expanded, stylocerite nearly half the length of this joint, distal spine small, second and third joints subequal, slender, flagella longer than stalk, the outer cleft for about $\frac{1}{4}$ of length of thicker part; antennal scale longer than antennular stalk, rather broad, subtruncate, with distal spine projecting beyond end; third maxilliped reaching end of first joint of antennule; first leg reaching end of antennal scale, its arm, wrist, and hand subequal, its fingers rather longer than its palm; second legs equal, each outreaching antennal scale by fingers and half palm, its fingers and all joints unarmed, wrist and arm subequal, hand nearly half as long again as wrist, palm and fingers subequal; last three legs slender, sparsely hairy, with a long spine at end of propodite, dactylopodites long, slender, simple, nearly straight.

Length of the longer of the two specimens, 17 mm.

Praslin, Seychelles.

27. *Periclimenes* (*Falciger*) *kolumadulensis* Borradaile, 1915 (Plate **55**, fig. 17).

Ann. Mag. Nat. Hist. (8), xv. p. 213.

Definition: Closely related to *P. borradailei* Rathbun, but differing in that (1) the rostrum is $2\frac{1}{2}$ times the length of the carapace behind it (not more than $1\frac{3}{4}$ times in *P. borradailei*), (2) the second leg is seven times the length of the carapace (five times in *P. borradailei*), (3) the last three legs are about $\frac{1}{5}$ longer than in *P. borradailei* of the same size, (4) the shape of the great chelæ is very different, the fingers of that on one side meeting and bearing a row of about a dozen small teeth, while those of the other gape widely and bear each two basal teeth and a distal cutting flange.

Length of the single specimen, 29 mm.

Kolumadulu Atoll, Maldive Is.

Subgenus Ensiger Borradaile, 1915.

Ann. Mag. Nat. Hist. (8), xv. p. 207.

Definition: Rostrum toothless, straight, of medium length. An absence of spines from trunk and limbs. Second wrist of medium length.

Type: *Periclimenes* (*Ensiger*) *aurantiacus* (Dorna), 1852.

Anchistia aurantiaca, Dana, U. S. Explor. Exped. xiii. p. 581 (1852); Atlas, Pl. 28, fig. 2 (1855).

Periclimenes aurantiacus, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 382 (1898).

Fiji, in coral.

Doubtful and wrongly placed species attributed to *Periclimenes*.

Periclimenes tenuipes (Leach).

Nobili, Ann. Mus. Univ. Napoli, ii. xxi. p. 5 (1907), alludes to this species, which he states to be of Mediterranean habitat. I have not been able to find the original description of it.

Periclimenes hertwigi Balss, 1914, and

Periclimenes gorgonidarum Balss, 1914.

Abh. k. Bayer. Ak. Wiss., Math.-Phys. Kl. ii. Suppl. Bd. x. p. 49 (1914).

These species do not belong to *Periclimenes*, and indeed appear from statements regarding their telsons not to be Pontoniinæ. Further information regarding the mouth-parts and gills of these very interesting forms is desirable.

Periclimenes hermitensis, Rathbun, 1914.

Proc. Zool. Soc. Lond., 1914, p. 655, Pl. 1, figs. 1—3.

The correct position of this species is probably in the genus *Ancyclocaris* (see above, p. 356).

Periclimenes sp. de Man, 1902.

Abh. Senckenb. Ges. xxv. iii. p. 833.

It is not possible to assign this species to any genus until further information concerning it be available.

Genus Pontoniopsis Borradaile, 1915.

Ann. Mag. Nat. Hist. (8), xv. p. 207. Potts, Proc. Camb. Philos. Soc. xviii. p. 59 (1915).

Definition: Body rather slender, compressed but with the cephalothorax somewhat flattened dorsally; rostrum short, shallow, lanceolate in *dorsal* view, toothless; a sharp antennal spine, but no hepatic or supraorbital spines; eye subspherical, with large cornea; outer flagellum of antennule not deeply cleft; antennal scale broad; mandible without palp; second maxilliped without podobranch, its last joint mediad of preceding joint; third maxilliped with vestigial arthrobranch, narrow in all joints; legs short, directed outwards, rather stout, second pair very unequal, the smaller of the type of the first pair, the larger with long, stout, parallel-sided palm and short fingers, dactylopodites of last three pairs stout, curving at tip to simple end-claw.

Type: *Pontoniopsis comanthi* Borradaile, 1915 (Plate **57**, fig. 27).

Ann. Mag. Nat. Hist. (8), xv. p. 213. Potts, Pap. Dep. Mar. Biol. Carnegie Inst. Washington, viii. p. 81, Pl. 1, fig. 3 (1915).

Pontoniopsis sp. Potts, Proc. Camb. Philos. Soc. xviii. pp. 59, 62 (1915).

Definition: Rostrum reaching end of second joint of antennular stalk, with slight keel above and deeper keel below, straight, its breadth much greater than its depth, about equal to greatest width of eye; basal joint of antennule broad, its expansion consisting of two broad spines, of which the foremost ends in the distal spinule and the hinder is the stylocerite, second and third joints broad and flattened, second longer than third, its distal angles sharp, flagella short, outer cleft to moderate depth; antennal scale outreaching antennular stalk, broad, with straight outer and convex inner sides, and subrectangular end, which is not nearly reached by the small distal spinule; antennal stalk outreaching basal joint of antennule, with basal spine well developed; third maxilliped not reaching end of antennal stalk, its last two joints subequal, together shorter than preceding joint; first leg outreaching antennular stalk by hand and wrist, arm and wrist subequal, hand rather shorter, fingers shorter than palm, hairy; longer leg of second pair outreaching antennular stalk by hand, wrist very short and wide, with a sharp process below at the end, hand about equal to preceding three joints, fingers much shorter than palm, bearing interlocking teeth; last three legs hairy at end, with stout dactylopodites curving at the top rather strongly to form a sharp end-claw; telson rather narrow, blunt ended, shorter than uropods.

Length of longest specimen, 8 mm.

Torres Straits, on *Comanthus*.

Genus Periclimenæus Borradaile, 1915.

Ann. Mag. Nat. Hist. (8), xv. p. 207.

Definition: Body rather stout, decidedly compressed, without sudden change in curvature of abdomen, suggestive of *Alpheus*; rostrum rather short, straight, with

convex upper and almost straight lower edge, bearing above a row of long, close-set, subequal teeth, but toothless below; a strong antennal, but no supraorbital or hepatic spine; eye subcylindrical with rather small cornea, which has a cup-shaped depression on the outer side; outer flagellum of antennule not deeply cleft; antennal scale of moderate breadth; mandible without palp; second maxilliped without podobranch, its last joint mediad of preceding joint; third maxilliped with vestige of arthrobranch, and with antepenultimate joint of medium breadth; legs rather stout, those of the second pair granulate, unequal, and in one of them the chela very heavy but not very long, with short, stout fingers, of which one bears a knob and the other a corresponding socket, those of last three pairs with short, stout, biunguiculate dactylopodites; submedian and intermediate spines of telson subequal.

Key to the species of *Periclimenæus*:

I. Two teeth of rostrum stand behind orbit. Moveable finger of second leg bears knob and fixed finger socket. Fringes on limbs not remarkably long.

P. robustus Borradaile, 1915.

II. None of rostral teeth stands behind orbit. Fixed finger of second leg bears knob and moveable finger socket. Fringes of limbs very long.

P. fimbriatus Borradaile, 1915.

1. (Type.) *Periclimenæus robustus* Borradaile, 1915 (Plate **55**, fig. 20).

Ann. Mag. Nat. Hist. (8), xv. p. 213.

Definition: Body rather strongly compressed; rostrum slightly outreached by antennal scale and rather more by antennular stalk, directed somewhat downwards, sublanceolate, its formula $\frac{2}{0}$; a strong antennal spine; first joint of antennular stalk long, but little expanded, second and third joints subequal; antennal stalk reaching end of second joint of antennule, scale subovate; antepenultimate joint of third maxilliped short, rather wide at base but narrowing towards penultimate joint, which nearly equals it in length, last joint shorter than penultimate; first leg outreaching antennular stalk by wrist and hand, wrist longer than arm, hand stout, the fingers a little shorter than the palm, a tuft of hairs on the moveable finger; second legs unequal, the larger without spines on any joint, its hand very large, stout, granulate and in parts spinulose, the fingers short, abruptly hooked at the tip, the moveable one very wide, with a blunt process which fits into a hollow on the fixed finger and a notch which receives a sharp tooth of the fixed finger, the smaller hand with the same general characters as the larger but shorter, more swollen, and with simple edges to the fingers; the walking legs moderately stout, with five spines on the propodites, and the dactylopodites short, stout, bearing a sharp end-claw and a smaller claw below it; telson as long as uropods, of moderate width, narrowing somewhat towards end, which is truncate.

In young specimens three or four of the teeth at the base of the rostrum are wanting.

Length of the longest specimen, 14 mm.

Amirante I., 20—39 fms.

2. *Periclimenæus fimbriatus* Borradaile, 1915 (Plate **55**, fig. 19).

Ann. Mag. Nat. Hist. (8), xv. p. 213.

Definition: Body rather stout, compressed; rostrum outreached by antennular stalk, and rather more by antennal scale, straight, with convex upper and almost straight lower edge, bearing above 4—7 subequal teeth, of which the first lies in front of the eyes, and without teeth below; strong antennal spine; first joint of antennular stalk moderately expanded, second shorter than third, outer flagellum fringed with long hairs; antennal scale of moderate length, with straight outer and convex inner sides, the latter fringed with very long hairs, distal spine small; third maxilliped with penultimate joint considerably longer than last joint, last two joints together equal in length to rest of limb, exopodite rather short, endopodite bearing a fringe of unusually long hairs; first leg outreaching antennal scale by hand and wrist, its wrist equal to arm, fingers equal to palm, hand stout and hairy; legs of second pair unequal, the larger, which may be on either side, about as long as body, no spine on any joint, hand very large, granulated, thick on the outer side and sharp edged on the inner, its fingers short, with a knob on the fixed one fitting into a socket in the moveable one, the smaller hand much like the larger but with simple fingers; last three legs moderately stout, with a group of long spines at the end of the propodites, and dactylopodites very short and stout and bearing two long, hooked claws; telson shorter than uropods, narrow, tapering, with rounded end; uropods fringed with very long hairs.

Length of the longest specimen, 9 mm.

Mulaku Atoll, Maldive Is. Providence I., to 50 fms.

Genus Harpiliopsis n. gen.

Definition: Body stout, depressed; sixth abdominal segment not elongate; rostrum of moderate length, lanceolate, toothed above and below; outer flagellum of antennule not deeply cleft; antennal scale broad; mandible without palp; second maxilliped without podobranch, with last joint mediad of preceding; third maxilliped with arthrobranch, and with last two joints narrow, antepenultimate joint broad or narrow; legs stout, directed outwards, the last three with hooked dactylopodites.

Key to the species of *Harpiliopsis*:

I. Antepenultimate joint of third maxilliped narrow.
H. depressus (Stimpson), 1860.

II. Antepenultimate joint of third maxilliped broad.
H. beaupresi (Audouin), 1825.

1. (Type.) *Harpiliopsis beaupresi* (Audouin), 1825 (Plate **55**, fig. 21).

Palæmon Beaupresii, Audouin, Descr. Egypte, Crust. p. 91 (1825). Savigny, Atlas, Crust. Pl. 10, fig. 4.

Harpilius Beaupresii, Heller, Sitz. k. Ak. Wiss. Wien, xliv. I. p. 280 (1861). Paulson, Crust. Red Sea, p. 113 (1875). de Man, Arch. Naturg. liii. I. p. 539 (1887). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 386 (1898). Nobili, Ann. Mus. Univ. Napoli, i. III. p. 3 (1904); Ann. Sci. Nat. (9), iv. p. 63 (1906).

? *Pontonia* (*Harpilius*) *dentata*, Richters, Decap. Mauritius, p. 165, Pl. 17, figs. 36—38 (1880).

Red Sea. E. Indies. Indian Ocean.

2. *Harpiliopsis depressus* (Stimpson), 1860 (Plate **56**, fig. 22).

Harpilius depressus, Stimpson, Proc. Ac. Philadelphia, 1860, p. 38. Rathbun, Bull. U. S. Fish Comm. xxiii. III. p. 920, fig. 68 (1903).

Anchistia spinigera, Ortmann, Speng. Zool. Jahrb. Syst. v. p. 511, Pl. 36, fig. 23 (1890). Lenz, Ib. xiv. p. 434 (1901).

Periclimenes spinigerus, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 383 (1898); Willey's Zool. Results, iv. p. 405 (1899).

The fixed finger of the great chela in this species varies in shape. Sometimes it has three teeth, of which the most distal is broader than the others. Sometimes this tooth loses its point and becomes a blade-like flange.

Indopacific, in corals.

Genus Harpilius Dana, 1852.

U. S. Explor. Exped. Crust. i. p. 575. Kingsley, Proc. Ac. Philadelphia, 1879, p. 423 (1880). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 386 (1898).

Definition: Body stout, depressed; sixth abdominal segment not elongate; rostrum of good length, toothed above and below, sharp ended; outer flagellum of antennule not deeply cleft; antennal scale of good breadth; mandible without palp; second maxilliped without podobranch, with last joint posterior to preceding joint; third maxilliped without arthrobranch, and with last two joints narrow, together longer than preceding joint, which is broad; legs stout, the last three with hooked dactylopodites.

Key to the species of *Harpilius**:

I. No hepatic spine. Second leg unarmed.
H. gerlachei Nobili, 1905.

II. A hepatic spine. Second leg bears one or more spines.

A. Fingers of second leg curved inwards. Inner edge of hand concave.
H. consobrinus de Man, 1902.

B. Fingers of second leg not curved inwards. Inner edge of hand almost straight.
H. lutescens Dana, 1852.

* The limits of this genus are doubtful. In most respects its characters are similar to those of the species on which I have founded *Harpiliopsis*, but the second maxilliped of the type of *Harpilius* is so remarkable that no species which does not share this peculiarity can be retained in the genus. The other species here included in *Harpilius* are so placed provisionally, until further information as to their second maxilliped is available. Sollaud states that the third maxilliped in this genus has no arthrobranch, but does not state what species he has seen.

1. (Type.) *Harpilius lutescens* Dana, 1852.

U. S. Explor. Exped. Rep. xiii. i. p. 576; Atlas, Pl. 38, fig. 4 (1855). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 386 (1898). Nobili, Ann. Mus. Napoli, i. iii. p. 3 (1901); Ann. Sci. Nat. Zool. (9), iv. p. 63 (1906).

Tongatabu, Red Sea.

2. *Harpilius consobrinus* de Man, 1902.

Harpilius lutescens, de Man, Arch. Naturg. liii. i. p. 536, Pl. 22 *a*, fig. 1 (1887).

Harpilius consobrinus, de Man, Abh. Senckenb. Ges. xxv. iii. p. 836, Pl. 26, fig. 54 (1902).

E. Indies.

3. *Harpilius gerlachei* Nobili, 1905.

Bull. Mus. Paris, 1905, iii. p. 160; Bull. Sci. Fr. Belg. xl. p. 45, Pl. 4, fig. 10 (1906).

Persian Gulf, "parmi les polypiers."

Genus Coralliocaris Stimpson, 1860.

Œdipus, Dana, U. S. Explor. Exped. Rep. xiii. i. p. 572 (1852).

Coralliocaris, Stimpson, Proc. Ac. Philadelphia, 1860, p. 38. Kingsley, Ib. 1879, p. 423 (1880). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 384 (1898). Ortmann, Bronn's Thierreich, Arthropoden, v. ii. p. 1131. Rathbun, Bull. U. S. Fish Comm. xx. ii. p. 122 (1901).

Definition: Body stout, depressed; sixth abdominal segment not elongate; rostrum of moderate or good length, with or without teeth, usually somewhat depressed, shallow, not curved downwards; outer flagellum of antennule not deeply cleft; antennal scale broad; mandible without palp; second maxilliped without podobranch, with last joint mediad of preceding joint, but often projecting far behind it; third maxilliped with arthrobranch and with last two joints usually broad, antepenultimate joint more or less broadened, not contrasting sharply in width with last two joints; legs stout, directed outwards, one or both of second pair with large chela, swollen at base and very short-fingered, the last three pairs with hooked dactylopodites and a basal protuberance, which is usually large.

Key to the subgenera of *Coralliocaris:*

I. Dactylopodites of walking legs with an accessory spine and small basal protuberance.

Onycocaris Nobili, 1904.

II. Dactylopodites of walking legs without accessory spine, and with basal protuberance of a good size.

Coralliocaris s. str.

Subgenus Coralliocaris s. str.

Definition: Dactylopodites with well-developed basal protuberance, without accessory spinules, not biunguiculate; great chela generally opens horizontally, or has the thumb below.

Key to the species of *Coralliocaris* s. str.

I. Rostrum toothless.

A. Rostrum reaches only to middle of first joint of antennule. Antennular stalk reaches middle of antennal scale.
C. brevirostris Borradaile, 1898.

B. Rostrum outreaches first joint of antennule. Antennular stalk nearly reaches end of antennal scale.
C. nudirostris (Heller), 1862.

II. Rostrum toothed.

A. Rostrum bears no teeth below.

1. Rostrum bears only one tooth above.
C. macrophthalma (H. M.-Edwards), 1837.

2. Rostrum bears 4—5 teeth above.

a. Rostrum curved upwards. Eyes subspherical.
C. atlantica Rathbun, 1901.

b. Rostrum not curved upwards. Eyes subcylindrical.

i. Rostrum straight, reaching middle of second joint of antennule. Great chela opens vertically.
C. hecate Nobili, 1904.

ii. Rostrum bent downwards, reaching end of second joint of antennule. Great chela opens horizontally.
C. quadridentata Rathbun, 1906.

B. Rostrum bears one or more teeth below.

1. Rostrum bears only one tooth above.
C. camerani Nobili, 1902.

2. Rostrum bears 4—6 teeth above.

a. Second legs subsimilar (often unequal).

i. Moveable finger not of great width or very much curved.

a. Rostrum rather deep. Great chela not long or much swollen at base.
C. truncata Rathbun, 1906.

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β. Rostrum shallow. Great chela elongate and swollen at base.

(1) Third maxilliped broad. Rostrum not as long as antennular stalk.

C. superba (Dana), 1852.

(2) Third maxilliped relatively narrow. Rostrum as long as antennular stalk.

C. japonica Ortmann, 1891.

ii. Moveable finger very wide and much curved.

C. graminea (Dana), 1852.

b. Second legs quite unlike.

C. lucina Nobili, 1901.

1. (Type.) *Coralliocaris superba* (Dana), 1852.

Œdipus superbus, Dana, U. S. Explor. Exped. Rep. xiii. i. p. 573 (1852); Atlas, Pl. 37, fig. 2 (1855).

Coralliocaris superba, Stimpson, Proc. Ac. Philadelphia, 1860, p. 38. de Man, Arch. Naturg. liii. i. p. 536 (1887). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 385 (1898). Nobili, Ann. Mus. Univ. Napoli, i. iii. p. 3 (1901). Ann. Sci. Nat. (9), iv. p. 55 (1906). Balss, Abh. k. Bayer. Ak. Wiss., Math.-Phys. Kl. ii. Suppl. Bd. x. p. 53 (1914).

Œdipus dentirostris, Paulson, Crust. Red Sea, i. p. 112, Pl. 14, fig. 7 (1875).

Indopacific, in corals.

2. *Coralliocaris macrophthalma* (H. M.-Edwards), 1837 (Plate **56**, fig. 24).

Pontonia macrophthalma, H. M.-Edwards, Hist. Nat. Crust. ii. p. 359 (1837); Cuvier's R. An., Crust., Atlas, Pl. 52, fig. 3 (1849).

Œdipus macrophthalmus, Dana, U. S. Explor. Exped. Rep. xiii. i. p. 573 (1852).

Coralliocaris macrophthalma, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 385 (1898). Nobili, Ann. Mus. Univ. Napoli, i. iii. p. 3 (1901).

"Mers d'Asie," Red Sea. Saya de Malha, to 26 fms.

3. *Coralliocaris graminea* (Dana), 1852.

Œdipus gramineus, Dana, U. S. Explor. Exped. Rep. xiii. i. p. 574 (1852); Atlas, Pl. 37, fig. 3 (1855).

Coralliocaris graminea, Stimpson, Proc. Ac. Philadelphia, 1860, p. 38. Miers, "Alert" Crust. p. 563 (1884). de Man, Arch. Naturg. liii. i. p. 536 (1887); Abh. Senckenb. Ges. xxv. iii. p. 840 (1902). Ortmann, Semon's Forschungsreisen in Austral. v. i. p. 16 (1894). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 385 (1898). Lenz, Abh. Senckenb. Ges. xxvi. iv. p. 381 (1905).

Coralliocaris inæqualis, Ortmann, Speng. Zool. Jahrb. Syst. v. p. 510, Pl. 26, fig. 21 (1890). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 386 (1898); Willey's Zool. Results, iv. p. 408 (1899). Balss, Abh. k. Bayer. Ak. Wiss., Math.-Phys. Kl. ii. Suppl. Bd. x. p. 33 (1914).

Indopacific, in corals.

4. *Coralliocaris lamellirostris* Stimpson, 1860.

Proc. Ac. Philadelphia, 1860, p. 38. Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 385 (1898). Nobili, Ann. Mus. Univ. Napoli, i. III. p. 5 (1901). Balss, Abh. k. Bayer. Ak. Wiss., Math.-Phys. Kl. ii. Suppl. Bd. x. p. 53 (1914).

Loo-Choo I., in corals.

5. *Coralliocaris nudirostris* (Heller), 1862.

Œdipus nudirostris, Heller, Sitz. k. Ak. Wiss. Wien, xliv. I. p. 279, Pl. 3, fig. 25 (1862).

Coralliocaris nudirostris, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 385 (1898).

Red Sea.

6. *Coralliocaris japonica* Ortmann, 1891 (Plate **56**, fig. 23).

Coralliocaris superba var. *japonica*, Ortmann, Speng. Zool. Jahrb. Syst. v. p. 509 (1890). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 385 (1898).

Professor Gardiner's collection contains a number of specimens of a *Coralliocaris* which is related to *C. superba* but differs from it in the following points:

(i) The rostrum is much narrower than in *C. superba*, and is at least as long as the antennular stalk, generally considerably longer.

(ii) The rostral formula is $\frac{3-5}{1}$, generally $\frac{4}{1}$.

(iii) The third maxilliped, though it is broader than in *Periclimenes*, is considerably narrower than in *C. superba*.

(iv) The hand of the first leg is longer, slender, and hairless, and its fingers are not more than half the length of the palm.

(v) The legs of the second pair are unequal, and the arm bears below at the end a flange with a sharp point. The wrist bears a tooth on the inner side, but the little teeth found on the upper side in *C. superba* are wanting. The smaller chela is of simple form, with the fingers nearly as long as the palm.

This species is probably the *C. superba* var. *japonica* of Ortmann.

Japan. Indian Ocean, to 26 fms.

7. *Coralliocaris brevirostris* Borradaile, 1898.

Ann. Mag. Nat. Hist. (7), ii. p. 386; Proc. Zool. Soc. Lond., 1898, p. 1006, Pl. 64 fig. 7 (1899).

Ellice Is.

8. *Coralliocaris lucina* Nobili, 1901.

Ann. Mus. Univ. Napoli, i. III. p. 5; Ann. Sci. Nat. (9), iv. p. 57 (1906).

Coralliocaris lamellirostris, de Man, Abh. Senckenb. Ges. xxv. III. p. 842, Pl. 26, fig. 5 (1902).

Red Sea. Ternate. In corals.

9. *Coralliocaris atlantica* Rathbun, 1901.

Bull. U. S. Fish Comm. xx. II. p. 122, fig. 26.
St Thomas, 20 to 23 fms.

10. *Coralliocaris camerani* Nobili, 1902.

Boll. Mus. Torino, xvi. XXIII. p. 3.
Flamenco I.

11. *Coralliocaris hecate* Nobili, 1904.

Bull. Mus. Paris, 1904, p. 232 ; Ann. Sci. Nat. (9), iv. p. 58, Pl. 3, fig. 2 (1906).
Jibuti.

12. *Coralliocaris rathbuni* n. nom.

Coralliocaris tridentata, Rathbun, Bull. U. S. Fish Comm. xxiii. III. p. 920, fig. 69, Pl. 24, fig. 1 (1906).
Hawaiian Is., 28 to 43 fms.

13. *Coralliocaris truncata* Rathbun, 1906.

Bull. U. S. Fish Comm. xxiii. III. p. 920, fig. 70, Pl. 24, fig. 2.
Hawaiian Is., 24 fms.

Subgenus Onycocaris Nobili, 1904.

Bull. Mus. Paris, 1904, p. 232 ; Ann. Sci. Nat. (9), iv. p. 60 (1906).

Definition: Dactylopodites with small basal protuberance, with accessory spinules, biunguiculate ; great chela opens vertically, with the thumb above.

Key to the species of *Coralliocaris* (*Onycocaris*) :

I. Rostrum toothless.

C. (*O.*) *aualitica* Nobili, 1904.

II. Rostrum toothed.

A. R. $= \frac{3}{0}$. No supraorbital spine.

C. (*O.*) *tridentata* Miers, 1884.

B. R. $= \frac{7-9}{0-1}$. A supraorbital spine.

C. (*O.*) *rhodope* Nobili, 1904.

1. *Coralliocaris* (*Onycocaris*) *aualitica* Nobili, 1904.

Bull. Mus. Paris, 1904, p. 232 ; Ann. Sci. Nat. (9), iv. Pl. 3, fig. 3 (1906).
Jibuti.

2. *Coralliocaris* (*Onycocaris*) *rhodope* Nobili, 1904.

Bull. Mus. Paris, 1904, p. 232 ; Bull. Sci. Fr. Belg. xl. p. 49 (1906) ; Ann. Sci. Nat. (9), iv. p. 61, Pl. 2, fig. 8 (1906).
Jibuti.

3. *Coralliocaris* (*Onycocaris*) *tridentata* (Miers), 1884.

Coralliocaris (?) *tridentata*, Miers, "Alert" Crust. p. 294. Pl. 32, fig. *c*. (1884). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 386 (1898).

Coralliocaris (*Onycocaris*) ? *tridentata*, Nobili, Ann. Sci. Nat. (9), iv. p. 60 (1906).

Thursday I.

Genus Coutierea Nobili, 1902.

Bull. Mus. Torino, xvi. 415, p. 4.

Definition: Body fairly slender, somewhat depressed, with regions of carapace well marked; abdominal pleura ridged and armed each with a spine, and sixth abdominal segment rather longer than the rest; antennal and supraorbital spines very large, hepatic and pterygostomian spines well developed; rostrum long and narrow, but shallow and simple; outer antennular flagellum not deeply cleft; antennal scale of a good breadth; mandible without palp (?); second maxilliped with last joint mediad of preceding joint and projecting but little behind it; third maxilliped narrower than in most *Coralliocaris*; legs rather stout, those of second pair unequal but similar, with regularly ovoid palm and long fingers, those of last three pairs with simple, moderately curved dactyles, bearing basal protuberance.

Type: *Coutierea agassizi* (Coutière), 1901.

Coralliocaris agassizi, Coutière, Bull. Mus. Paris, vii. p. 115 (1901).

Coutierea agassizi, Nobili, Boll. Mus. Torino, xvi. 415, p. 4 (1902).

Barbados, deep water.

Genus Stegopontonia Nobili, 1906.

Bull. Mus. Paris, xii. p. 258; Mem. Ac. Sci. Torino (2), lvii. p. 360 (1907).

Definition: Body fairly slender, a little depressed, with short carapace; which bears only a small antennal spine; rostrum toothless, broad, depressed, lanceolate in *dorsal* view; outer antennular flagellum not deeply cleft; antennal scale rather narrow, with long distal spine; mandible without palp; second maxilliped with last joint mediad of preceding joint; third maxilliped broad (?); legs rather stout, those of second pair unequal and unlike, the smaller of Palæmonid form, the larger with elongate, swollen palm and short fingers, those of last three pairs with short, deep, curved dactylopodites, bearing a pair of basal prominences.

Type: *Stegopontonia commensalis* Nobili, 1906.

Bull. Mus. Paris, xii. p. 258; Mem. Ac. Sci. Torino (2), lvii. p. 360, Pl. 1, fig. 2 (1907).

Hao I., Polynesia, on *Echinothrix turcarum*.

Genus Pontonides n. gen.

Definition: Body stout, depressed; sixth abdominal segment not elongate; rostrum short, flat horizontally, subtriangular, curved downwards, not dentate, with slight keels above and below; eye well developed; outer flagellum of antennule not deeply cleft; antennal scale broad; mandible without palp; maxillipeds without exopodites, second maxilliped without podobranch, with last joint mediad of preceding joint; third maxilliped with vestigial arthrobranch and with all joints broad; legs moderately stout, last three ending in simple, nearly straight dactylopodites without basal prominence.

Type: *Pontonides maldivensis* (Borradaile), 1915 (Plate **57**, fig. 28).

Pontonia maldivensis, Borradaile, Ann. Mag. Nat. Hist. (8), xv. p. 213 (1915).

Definition: Body much depressed; carapace broader than long, with small spine behind antenna and a blunt process below it; rostrum not reaching end of first joint of antennule, sharp pointed both in horizontal and in vertical view; first joint of antennular stalk broad, its spines sharp but not very long, third joint a little longer than second, flagella of a fair length; antennal scale ovate, longer than antennular stalk, its distal spine very small; last two joints of third maxilliped but little twisted from horizontal plane; first leg outreaching antennular stalk by hand and part of wrist, hand and wrist subequal, each rather shorter than arm, fingers equal to palm; second legs unequal, the larger about twice as long as carapace but shorter than body, its hand long, parallel-sided, with short, simple fingers, smaller hand with short swollen palm and long, slender, simple fingers; last three legs with long, slender dactylopodites; telson shorter than uropods.

Length of longest specimen, 7 mm.

Fadiffolu Atoll, Maldive Is.

Genus Anchistus Borradaile, 1898.

Ann. Mag. Nat. Hist. (7), ii. p. 387. Nobili, Bull. Sci. Fr. Belg. xl. p. 48 (1906).

Tridacnocaris, Nobili, Ann. Mus. Genova, xl. p. 235 (1899).

Marygrande, Pesta, Zool. Anz. xxxviii, p. 571 (1911).

Definition: Body stout, usually swollen and somewhat depressed; sixth abdominal segment not elongate; rostrum of fair length, compressed, bent or curved downwards, with broad, usually rounded end, dentate at the tip only or without teeth; outer flagellum of antennule not deeply cleft; antennal scale broad; mandible without palp; inner lacinia of maxillule broad and hairy; second maxilliped without podobranch, with last joint mediad of preceding joint; third maxilliped with vestigial arthrobranch, and with last two joints narrow, together longer than preceding joint, which is broad or narrow; legs stout, directed outwards, the last three with curved dactylopodites, with or without a small tooth on the lower side, without basal protuberance.

Key to the species of *Anchistus*:

I. Last two joints of third maxilliped contrast strongly in width with antepenultimate.

A. Rostrum shallow, pointed at end.

A. mirabilis (Pesta), 1911.

B. Rostrum deep, rounded at end,

A. inermis (Miers), 1884.

II. Last two joints of third maxilliped do not contrast strongly in width with antepenultimate.

A. Rostrum toothed.

A. miersi (de Man), 1888.

B. Rostrum toothless.

1. Rostrum rounded at end. Moveable finger of second cheliped much longer than fixed finger.

A. biunguiculatus Borradaile, 1898.

2. Rostrum ends in a sharp point. Fingers of second cheliped subequal.

A. spinuliferus (Miers), 1884.

1. (Type.) *Anchistus miersi* (de Man), 1888 (Plate **56**, fig. 25).

Harpilius Miersi, de Man, Journ. Linn. Soc. Lond., Zool. xxii. p. 274, Pl. 17, figs. 6—10 (1888). Whitelegge, Mem. Austral. Mus. iii. p. 148 (1897).

Anchistus miersi, Borradaile, Ann. Mag. Nat. Hist. (7), p. 387 (1898); Willey's Zool. Results, iv. p. 408 (1899). Lanchester, Proc. Zool, Soc. Lond. 1901, p. 565 (1902). Nobili, Bull. Sci. Fr. Belg. xl. p. 48 (1906); Mem. Ac. Torino (2), lvii. p. 357 (1907).

Indopacific, in various Lamellibranchs.

2. *Anchistus inermis* (Miers), 1884.

Harpilius inermis, Miers, "Alert" Crust. p. 291, Pl. 32, fig. B (1884). Müller, Verh. nat. Ges. Basel, viii. II. p. 471 (1887).

Anchistus inermis, Borradaile, Ann. Mag. Nat. Hist. (7) ii. p. 387 (1898). Pearson, Rep. Ceylon Pearl Fisheries, iv. p. 77 (1905). Rathbun, Proc. Zool. Soc. Lond. 1914, iii. p. 656 (1914).

Indian Ocean, in *Pinna*.

3. *Anchistus spinuliferus* (Miers), 1884.

Harpilius spinuliferus, Miers, "Alert" Crust. p. 292 (1884).

Anchistus spinuliferus, Borradaile, Ann. Mag. Nat. Hist. (7) ii. p. 387 (1884).

Loc.? In *Tridacna*.

4. *Anchistus biunguiculatus* Borradaile, 1898.

Ann. Mag. Nat. Hist. (7) ii. p. 387; Willey's Zool. Results, iv. p. 408, Pl. 1, fig. 5 (1899).

British New Guinea, in *Tridacna*.

5. *Anchistus mirabilis* (Pesta), 1911.

Marygrande mirabilis, Pesta, Zool. Anz. xxxviii. p. 571.
Samoa, in *Tridacna gigas*.

6. *Anchistus* (?) *armatus* (H. M.-Edwards), 1837.

Pontonia armata, H. M.-Edwards, Hist. Nat. Crust. ii. p. 359 (1837).
Anchistus (?) *armatus*, Borradaile, Ann. Mag. Nat. Hist. (7) ii. p. 387 (1898).
New Zealand.

Genus *Pontonia* Latreille, 1829.

Cuvier's R. An. 2nd ed. iv. p. 96. Roux, Mém. s. les Salicoques, p. 26 (1831). H. M.-Edwards, Hist. Nat. Crust. ii. p. 358 (1837). De Haan, von Siebold's Fauna Japonica, Crust. p. 175 (1850). Dana, U.S. Explor. Exped. Rep. xiii. I. p. 570 (1852). Kingsley, Proc. Ac. Philadelphia, 1879, p. 422 (1880). Joliet, Arch. zool. exper. x. p. 19 (1882). Carus, Prodr. Faun. Medit. i. p. 475 (1885). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 388 (1898). Ortmann, Bronn's Thierreich, Arthropoden, v. II. p. 1131 (1899). Rathbun, Bull. U.S. Fish Comm. xx. II. p. 121 (1901).

Definition: Body stout, swollen, somewhat depressed; sixth abdominal segment not elongate; rostrum short, depressed, curved downwards, not dentate, with or without a keel below at the free end; eye more or less reduced, outer flagellum of antennule not deeply cleft; antennal scale broad; mandible without palp; inner lacinia of maxillule very broad and hairy; second maxilliped without podobranch, with last joint mediad of preceding joint; third maxilliped without arthrobranch and with all joints broad, but the widest surface of the last two in a different plane from that of the antepenultimate, so that they are apt to appear narrow; legs stout, directed outwards, the second pair with heavy chela, the last three with dactylopodite nearly straight, simple, and without basal protuberance.

Key to the species of *Pontonia*:

I. Rostrum reaches at least to middle of second joint of antennule.

A. Last three legs end in simple claw. Southern species.

1. Rostrum outreaches antennular stalk. Dactylopodites of last three legs strong. Second legs subequal and similar.
P. minuta Baker, 1907.

2. Rostrum ends at middle of second joint of antennular stalk. Dactylopodites of last three legs weak. Second legs unequal and unlike.
P. pinnæ Ortmann, 1894.

B. Last three legs end in double claws. Northern species.

1. Rostrum very narrow throughout. W. American.
P. californiensis Rathbun, 1902.

2. Rostrum broad at base. Old World and Atlantic.

a. Antennal stalk as long as antennular. Eyes and first joint of antennular stalk subequal. Japanese.

P. nipponensis de Haan, 1850.

b. Antennal stalk shorter than antennular. First joint of antennular stalk distinctly longer than eyes. Western species.

i. Antennal scale has a spine and outreaches antennular stalk. Mediterranean.

α. Third maxilliped does not reach end of antennular stalk. Body bears yellow spots.

P. flavomaculata Heller, 1864.

β. Third maxilliped reaches end of antennular stalk. Body rose-pink.

P. tyrrhena (Petagna).

ii. Antennal scale has no spine and does not outreach antennular stalk W. Indies.

P. grayi Rathbun, 1901.

II. Rostrum short, not reaching end of first joint of antennule.

A. Rostrum reaches middle of first joint of antennule.

1. Rostrum without keel below.

P. ascidicola Borradaile, 1898.

2. Rostrum with keel below.

P. mexicana Guérin, 1856.

B. Rostrum not more than $\frac{1}{6}$ length of first joint of antennule.

P. brevirostris Miers, 1884.

1. (Type.) *Pontonia tyrrhena* (Petagna) (Plate **57**, fig. 29).

Astacus tyrrhenus, Petagna, Ent. Pl. 5, fig. 5 (*fide* Risso).

Gnathophyllum tyrrhenus, Desmarest, Consid. sur les Crust. p. 229.

Alpheus pinnophylax, Otto, Mém. Ac. cur. nat. Bonn, xiv. Pl. 21, figs. 1, 2.

Pontonia tyrrhena, Latreille, Encycl. Pl. 326, fig. 10; Cuvier's R. An. 2nd ed. p. 96 (1829). H. M.-Edwards, Crust. ii. Pl. 360 (1837). Cuvier's R. An. Crust. Atlas, Pl. 52, fig. 4 (1849). Heller, Crust. südl. Eur. p. 251, Pl. 8, figs. 10, 11 (1863). Ortmann, Speng. Zool. Jahrb. Syst. v. p. 509, Pl. 27, fig. 9 (1891). Nobili, Bull. Sci. Fr. Belg. xl. p. 49 (1906).

Callianassa thyrrhenus, Risso, Hist. Nat. Eur. Mér. p. 54 (1826).

Pontonia custos, Guérin, Expéd. Morée, Zool. p. 36, Pl. 37, fig. 1. Carus, Prodr. Faun. Medit. p. 475 (1885). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 388 (1898).

? *Pontonia parasitica*, Roux, Mém. sur les Salicoques, p. 26 (1831).

Mediterranean. In lamellibranchs and sponges.

2. *Pontonia nipponensis* De Haan, 1850.

Von Siebold's Fauna Japonica, Crust. p. 180. Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 388 (1878). Balss, Abh. k. Bayer. Ak. Wiss., Math.-Phys. Kl. ii. Suppl. Bd. 10, p. 53 (1914).

Hymenocera nipponensis, De Haan, *loc cit.* Pl. 46, fig. 8 (1850).

Japan.

3. *Pontonia mexicana* Guérin, 1856.

De la Sagra's Hist. Cuba. Rathbun, Bull. U. S. Fish. Comm. xx. II. p. 122 (1901).

? *Pontonia unidens*, Kingsley, Proc. Ac. Philadelphia, 1879, p. 422, Pl. 14, fig. 9 (1880). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 389 (1898).

Mid-west Atlantic.

4. *Pontonia flavomaculata* Heller, 1864.

Verh. zool.-bot. Ges. Wien, xiv. p. 51. Carus, Prodr. Faun. Medit. i. p. 475 (1885). Ortmann, Speng. Zool. Jahrb. Syst. v. p. 509 (1890).

Pontonia diazonæ, Joliet, Arch. Zool. Exper. x. p. 108 (1882).

Pontonia phallusiæ, Marion, Ann. Mus. Nat. Hist. Marseille, Zool. i. (1883). Gourret, Compt. Rend. civ. p. 187 (1887).

Mediterranean, in ascidians.

5. *Pontonia brevirostris* Miers, 1884.

"Alert" Crust. p. 562, Pl. 51, fig. B. Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 389 (1898).

Seychelles, "in clamp (clam ?) shells."

6. *Pontonia pinnae* Ortmann, 1894.

Jena. Denkschr. viii. p. 16, Pl. 1, fig. 3. Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 389 (1898). Nobili, Ann. Sci. Nat. (9), iv. p. 65 (1906); Bull. Sci. Fr. Belg. xl. p. 46, Pl. 4, fig. 11 (1906).

? *Cancer custos* Forskål, Descrip. Anim. p. 94 (1775).

Red Sea. E. Africa. In *Pinna*.

7. *Pontonia ascidicola* Borradaile, 1898.

Ann. Mag. Nat. Hist. (7), ii. p. 389; Willey's Zool. Results, iv. p. 409, Pl. 1, fig. 6 (1899).

New Britain, in ascidian.

8. *Pontonia grayi* Rathbun, 1901.

Bull. U. S. Fish Comm. xx. II. p. 122.

Porto Rico.

9. *Pontonia californiensis* Rathbun, 1902.

Proc. U. S. Mus. xxiv. p. 902; Dec. Crust. N.W. America, p. 33, fig. 34 (1904).

California.

10. *Pontonia minuta* Baker, 1907.

Tr. Roy. Soc. S. Australia, xxxi. p. 189, Pl. 24, figs. 9—12.
S. Australia.

Genus Conchodytes Peters, 1851.

Ges. naturf. Freunde Berlin, 1851 (*fide* Hilgendorf); Ber. k. Ak. Wiss. Berlin, 1852, p. 591. Hilgendorf. Monatsber. k. Ak. Wiss. Berlin, 1875, p. 835. Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 389 (1898).

Definition: Body stout, swollen, depressed; sixth abdominal segment not elongate; rostrum short, depressed, curved downwards, toothless, with a keel below; eye small, outer flagellum of antennule not deeply cleft; flagella of antennule always, and that of antenna often, very short; antennal scale broad; mandible without palp; inner lacinia of maxillule very broad and hairy; second maxilliped without podobranch, with last joint mediad of preceding joint; third maxilliped without arthrobranch, with all joints broad, but with widest surface of last two in different plane from that of antepenultimate; legs stout, directed outwards, the second pair with heavy chela, the last three with strongly curved dactylopodites which bear basal protuberance.

Key to the species of *Conchodytes*:

I. Flagellum of antenna less than twice length of rostrum. Latter ends bluntly. Distal spine of antennal scale projects beyond end of scale. Indopacific.

A. Fingers of chelae without projection on outer side.

1. Rostrum outreaches antennal scale.
C. tridacnæ Peters, 1851.

2. Rostrum does not outreach antennal scale.
C. meleagrinæ Peters, 1851.

B. Moveable finger of one of second chelæ bears square projection on outer side.
C. biunguiculata (Paulson), 1875.

II. Flagellum of antenna a good deal more than twice length of rostrum. Latter ends in sharp spine. Distal spine of antennal scale does not reach end of scale. American.

A. Palm of great chela more than half as wide as long. Third maxilliped does not reach end of antennal stalk Panama.
C. margarita (Verrill), 1869.

B. Palm of great chela less than half as wide as long. Third maxilliped slightly outreaches antennal stalk. W. Atlantic.
C. domestica (Gibbes), 1851.

1. (Type.) *Conchodytes tridacnæ* Peters, 1851.

Ges. naturf. Freunde Berlin, 1851 (*fide* Hilgendorf); Ber. k. Ak. Wiss. Berlin, 1852, p. 594; Arch. Naturg. xviii. p. 288 (1852). Hilgendorf, Monatsber. k. Ak. Wiss. Berlin, 1878, p. 835. Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 390 (1898); Proc. Zool. Soc. Lond. 1898, p. 1007 (1899); Willey's Zool. Results, iv. p. 407 (1899). Nobili, Ann. Mus. Genova, xl. p. 235 (1899); Ann. Sci. Nat. (9), iv. p. 66 (1906).

Pontonia tridacnæ, Dana, U. S. Explor. Exped. Rep. xiii. 1. p. 371 (1852); Atlas, Pl. 37, fig. 1 (1885). Miers, "Alert" Rep. Crust. p. 290 (1884). ?Ortmann, Speng. Zool. Jahrb. Syst. v. p. 509, Pl. 37, fig. 10 (1891).

Indopacific, in *Tridacna*.

The separation of this species from *C. meleagrinæ* is difficult. Peters, whose statements are none too explicit, gives several points of difference, but these all vary independently, with the exception of that which consists in the absence of a fringe to the antennal scale in *C. tridacnæ*. I have not met with this feature, and believe it to have been due to accident in Peters' specimens. Examination of a number of specimens from various localities shows the following facts: (1) specimens in which the rostrum outreaches the antennal scale always have the third maxilliped falling considerably short of the end of the rostrum, and the arm of the first leg no longer than the wrist, and are always found in *Tridacna*, (2) specimens in which the rostrum is outreached by the antennal scale may have the third maxilliped reaching or exceeding the end of the rostrum, and may have the arm of the first leg longer than the wrist, and are usually, though not always, found in *Meleagrina*. Form (1) is presumably *C. tridacnæ*, and form (2) *C. meleagrinæ*. Whether they are specifically distinct is another question. In both forms the chelipeds of the second pair vary greatly both in degree of inequality and in the actual size of the greater of them.

2. *Conchodytes meleagrinæ* Peters, 1851 (Plate **57**, fig. 26).

Ges. naturf. Freunde Berlin, 1851 (*fide* Hilgendorf); Ber. k. Ak. Wiss. Berlin, 1852, p. 594; Arch. Naturg. xviii. p. 288 (1852). Hilgendorf, Monatsber. k. Ak. Wiss. Berlin, 1878, p. 836. Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 390 (1898). Nobili, Mem. Ac. Torino (2), lvii, p. 59 (1907). Pearson, Rep. Ceylon Pearl Fisheries, iv. p. 77 (1905).

Pontonia meleagrinæ, Bate, "Challenger" Macrura, p. 707, Pl. 124, figs. 1, 2 (1888).

Pontonia tridacnæ, Miers, "Alert" Rep. Crust. p. 290 (1884).

?*Pontonia maculata*, Stimpson, Proc. Ac. Philadelphia, 1860, p. 38. Balss, Abh. k. Bayer. Ak. Wiss., Math.-Phys. Kl. ii. Suppl. Bd. x. p. 53 (1914).

?*Pontonie enflée*, H. M.-Edwards, Hist. Nat. Crust. ii. p. 360 (1837).

Indopacific, in *Meleagrina*, and occasionally in *Tridacna*.

3. *Conchodytes domestica* (Gibbes), 1850.

Pontonia domestica, Gibbes, Proc. Am. Assoc. iii. p. 196 (1850). Kingsley, Proc. Ac. Philadelphia, 1878, p. 95.

Pontonia (?) *domestica*, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 389 (1898).

Conchodytes domestica, Rathbun, Bull. U. S. Fish Comm. 1900, ii. p. 122 (1901).
Bahamas, S.E. United States, in *Pinna*. Porto Santo, in *Pecten* (Brit. Mus.).

4. *Conchodytes margarita* (Verrill), 1869.

Pontonia margarita Smith, Verrill, Amer. Nat. iii. p. 245 (1869). Lockington, Bull. Essex Inst. xi. p. 163 (1878).
Conchodytes margarita, Rathbun, Dec. Crust. N.W. America, p. 34 (1904).
Panama, in *Margaritophora fimbriata*.

5. *Conchodytes biunguiculata* (Paulson), 1875.

Pontonia biunguiculata, Paulson, Crust. Red Sea, p. 111, Pl. 15, fig. 1 (1875).
Conchodytes biunguiculata, Nobili, Ann. Sci. Nat. (9), iv. p. 67 (1906).
Red Sea.

Genus Typton Costa, 1844.

Ann. Ac. Aspir. Nat. Napoli, ii.; Faun. Regn. Napoli, ii. i. (1846). Heller, Crust. südl. Eur. p. 254 (1863). Bate, Ann. Mag. Nat. Hist. (4), ii. p. 119 (1868). Kingsley, Proc. Ac. Philadelphia, 1879, p. 422 (1880). Carus, Prodr. Faun. Medit. i. p. 475 (1885). Ortmann, Speng. Zool. Jahrb. Syst. v. p. 508 (1890); Bronn's Thierreich, Arthropoden, v. ii. p. 1131 (1899). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 390 (1898).
Pontonella, Heller, Verh. zool.-bot. Ver. Wien, vi. p. 629 (1856).

Definition: Body stout, compressed; sixth abdominal segment not elongate; rostrum short, compressed, bent upwards at free end, pointed, with few or no teeth; outer flagellum of antennule short, not cleft; antennal scale vestigial; second maxilliped without podobranch, with last joint mediad of preceding joint; third maxilliped without arthrobranch, with narrow endopodite; legs fairly stout, one of the second pair with a very large chela, the dactylopodites of the last three much or little curved, biunguiculate, without basal protuberance.

Key to the species of *Typton*:

I. Rostrum toothless. Dactylopodites of last three legs not strongly curved.
T. spongicola Costa, 1844.

II. Rostrum toothed. Dactylopodites of last three legs strongly curved.
T. bouvieri Nobili, 1904.

1. (Type.) *Typton spongicola* Costa, 1844.

Ann. Ac. Aspir. Nat. Napoli, ii.; Faun. Reg. Napoli, ii. i. Pl. 6, figs. 1—6 (1846). Grube, Ausflug nach Triest, pp. 65 and 125. Heller, Crust. südl. Eur. p. 254, Pl. 8, figs. 12—17 (1863). Norman, Ann. Mag. Nat. Hist. (4), ii. p. 176 (1868). Carus, Prodr. Faun. Medit. i. p. 475 (1885). Ortmann, Speng. Zool. Jahrb. Syst. v. p. 508, Pl. 37, fig. 8 (1891). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 390 (1898).

Pontonella glabra, Heller, Ver. zool.-bot. Ver. Wien, 1856, p. 629, Pl. 9, figs. 1—15.

Alpheus edwardsii, Couch, Journ. Linn. Soc. Lond., Zool. v. p. 210 (1860).

Typton spongiosus, Bate, Ann. Mag. Nat. Hist. (4), ii. p. 119 (1868).

Mediterranean. Cornwall. In sponges.

2. *Typton bouvieri* Nobili, 1904.

Bull. Mus. Paris, 1904, v. p. 233; Ann. Sci. Nat. (9), iv. p. 67, Pl. 3, fig. 4 (1906).

Jibuti.

EXPLANATION OF PLATES 52—57.

Fig. 1. *Periclimenes spiniferus* de Man, 1902 (Plate 52). *a*, side view; *b*, dorsal view of cephalothorax; *c*, dorsal view of antennule and antenna with adjacent structures: α = coxocerite, β = basicerite (outer division), δ = scale, ϵ = base of eyestalk, ii = second joint of endocerite; *c'*, ventral view of base of antenna, lettering as in *c*, also β^* = inner division of basicerite, γ = tubercle for opening of green gland, i = first joint of endocerite; *d*, ventral view of left mandible; *d'*, end of molar process of the same; *d'''*, end of molar process of right mandible; d^{iv}, anterior view of right mandible; *e*, maxillule; *f*, maxilla; *g*, 1st maxilliped; *h*, 2nd maxilliped; *i*, 3rd maxilliped, removed with arthrobranch; *k*, chela of 1st leg; *l*, chela of 2nd leg (larger of pair); *m*, walking leg; *n*, 1st abdominal limb of male; *o*, 2nd abdominal limb of male; *o'*, 2nd abdominal limb of female; *p*, dorsal view of telson; *q*, paragnatha.

Fig. 2. *Urocaridella gracilis* Borradaile, 1915 (Plate 53). *a*, *e*, *f*, *g*, *h*, *i*, *n*, *o*, *p*, as fig. 1; d^{iv}, anterior-ventral view of right mandible; *o''*, 3rd abdominal limb of male.

Fig. 3. *Urocaris psamathe* de Man, 1902 (Plate 53). *e*—*i*, as fig. 1.

Fig. 4. *Palæmonella elegans* Borradaile, 1915 (Plate 53). Side view of forepart of body.

Fig. 5. *Palæmonella longirostris* Borradaile, 1915 (Plate 53). *a*, as fig. 1; d^{v}, anterior-ventral view of left mandible.

Fig. 6. *Periclimenes frater* Borradaile, 1915 (Plate 53). *c*, basal joint of right antennule in dorsal view; *m*, end of a walking leg.

Fig. 7. *Periclimenes incertus* Borradaile, 1915 (Plate 53). Side view.

Fig. 8. *Periclimenes brocki* (de Man), 1887 (Plates 53, 54). *f*, *g*, *h*, *i*, as fig. 1.

Fig. 9. *Periclimenes ceratophthalmus* Borradaile, 1915 (Plate 54). *b*, as fig. 1; *a*, side view of carapace.

Fig. 10. *Periclimenes cornutus* Borradaile, 1915 (Plate 54). *a*, *b*, as fig. 1.

Fig. 11. *Periclimenes affinis* Borradaile, 1915 (Plate 54). *a*, *b*, *e*, *g*, *h*, *i*, *p*, as fig. 1.

Fig. 12. *Periclimenes dubius* Borradaile, 1915 (Plate 54). *a*, *b*, *p*, as fig. 1.

Fig. 13. *Periclimenes nilandensis* Borradaile, 1915 (Plate 54). *a*, *b*, as fig. 1.

Fig. 14. *Periclimenes seychellensis* Borradaile, 1915 (Plates 54, 55). *a*, *b*, *e*, *f*, *h*, *i*, as fig. 1.

Fig. 15. *Periclimenes brocketti* Borradaile, 1915 (Plate 55). *a*, *b*, as fig. 1.

Fig. 16. *Periclimenes suvadivensis* Borradaile, 1915 (Plate 55). Side view.

Fig. 17. *Periclimenes kolumadulensis* Borradaile, 1915 (Plate 55). *l*, *l'*, chelæ of second pair.

Fig. 18. *Periclimenes compressus* Borradaile, 1915 (Plate 55). *a*, *b*, as fig. 1.

Fig. 19. *Periclimenæus fimbriatus* Borradaile, 1915 (Plate 55). *a*, *b*, *i*, *l*, *m*, *p*, as fig. 1.

Fig. 20. *Periclimenæus robustus* Borradaile, 1915 (Plate 55). *a*, *b*, *f*, *g*, *h*, *i*, as fig. 1.

Fig. 21. *Harpiliopsis beaupresi* (Audouin), 1825 (Plate 55). Third maxilliped.

Fig. 22. *Harpiliopsis depressus* (Stimpson), 1860 (Plate 56). *e*—*i*, as fig. 1.

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Fig. 23. *Coralliocaris* sp. ? *C. japonica* (Ortmann), 1891 (Plate **56**). *f*, *i*, *l*, *m*, as fig. 1; *a'*, side view of rostrum; *b'*, dorsal view; *l'*, small chela of second pair.

Fig. 24. *Coralliocaris macrophthalma* (H. M.-Edwards), 1837 (Plate **56**). Third maxilliped.

Fig. 25. *Anchistus miersi* (de Man), 1888 (Plate **56**). *e*—*i*, as fig. 1.

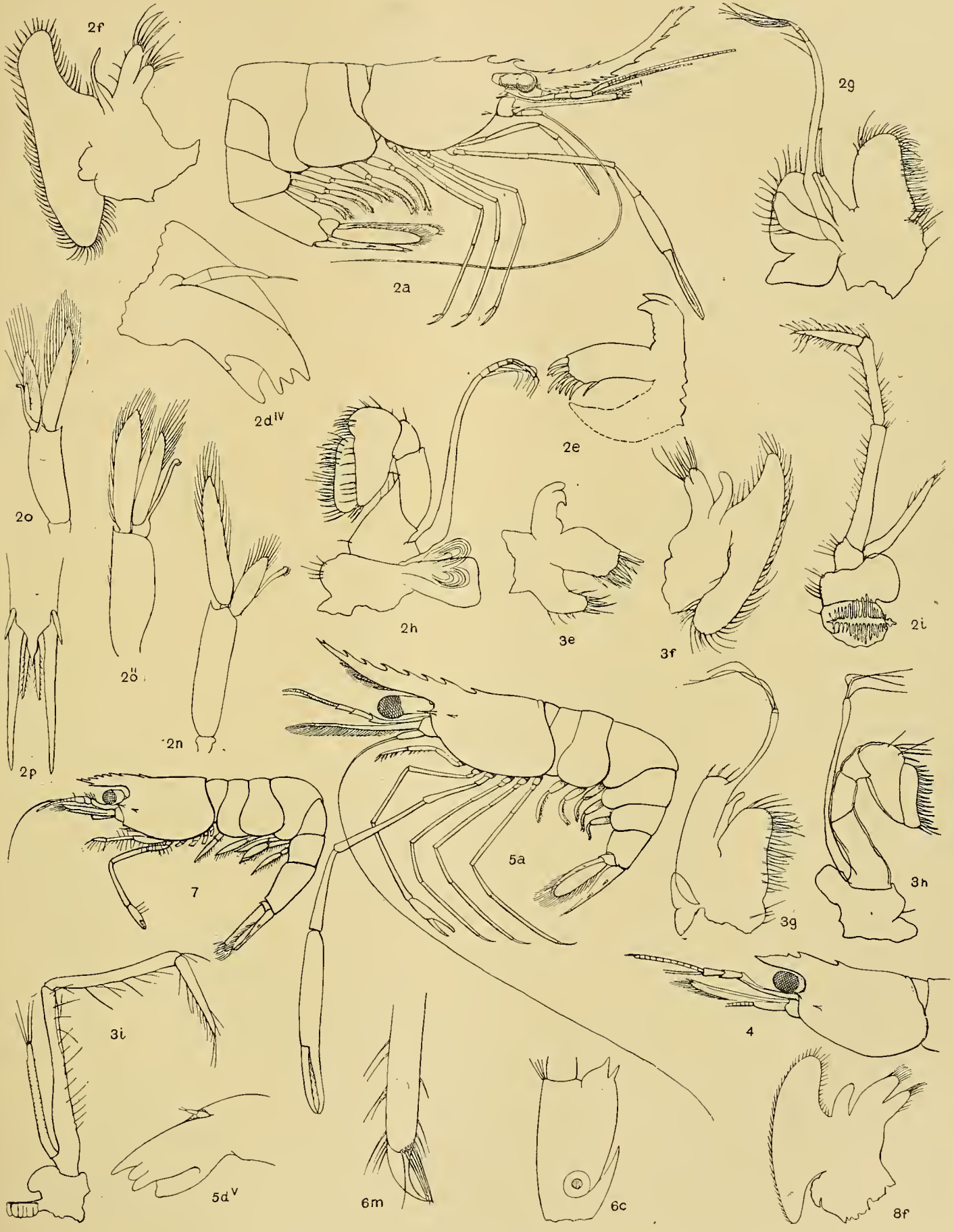
Fig. 26. *Conchodytes meleagrinæ* Peters, 1851 (Plate **57**). *a'*, *b'*, views as fig. 23 of female specimen with tail fan turned forward; *d*, *d'*, *d'''*, *e*, *f*, *g*, *h*, *i*, *m*, as fig. 1; *d''*, view of end of molar process of left mandible from dorsal side; *r*, ventral view of region of mouth, semidiagrammatic; *s*, the same, after removal of maxillipeds and maxillæ; *t*, the same, after removal of maxillules and paragnatha.

Fig. 27. *Pontoniopsis comanthi* Borradaile, 1915 (Plate **57**). Dorsal view of rostrum and eyes.

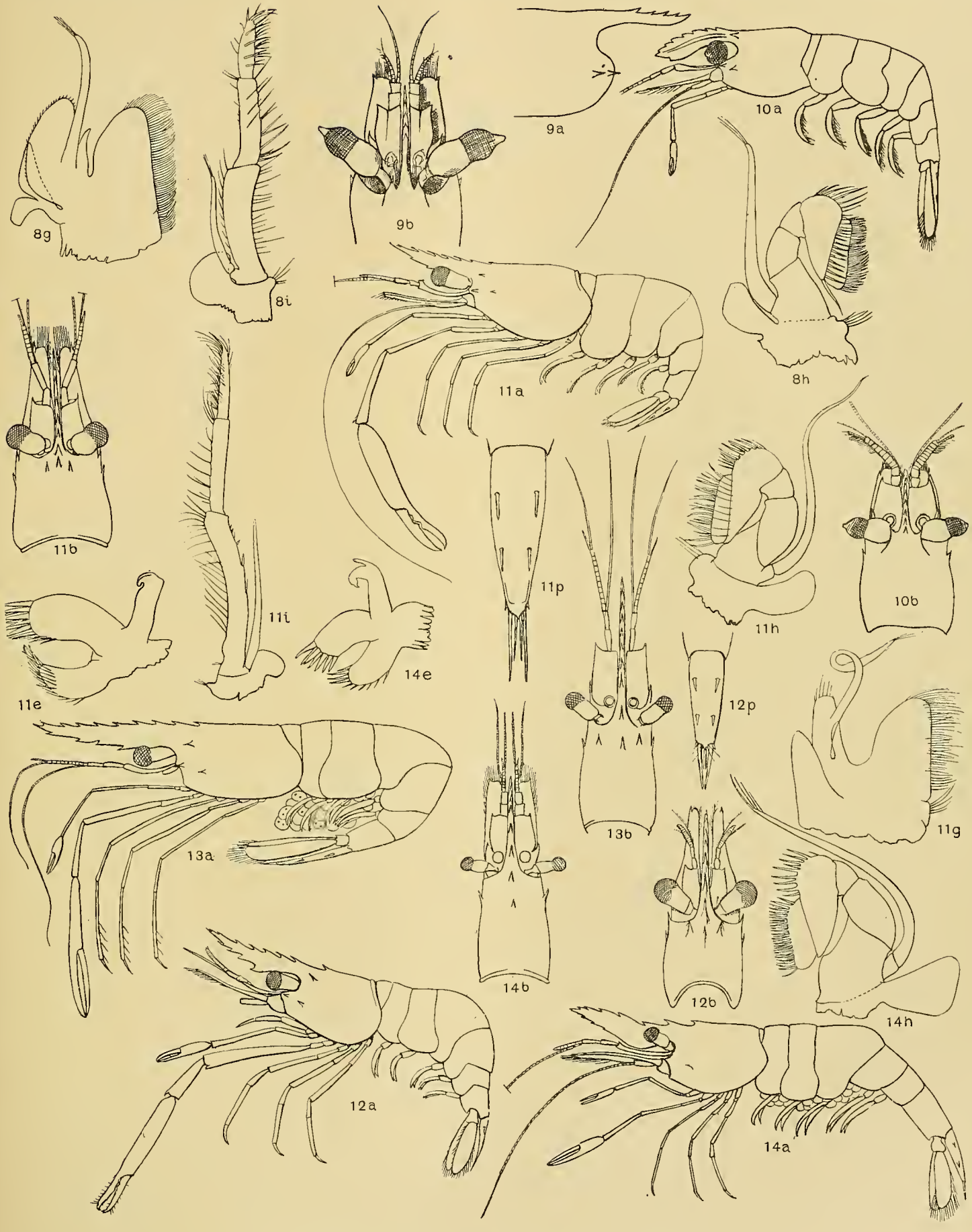
Fig. 28. *Pontonides maldivensis* (Borradaile), 1915 (Plate **57**). *a*, *i*, as fig. 1; *b*, dorsal view of rostrum and eyes.

Fig. 29. *Pontonia tyrrhena* (Petagna) (Plate **57**). ♂ male specimen in dorsal view, after Milne-Edwards; ♀ female specimen in dorsal view.

PONTONIINÆ FROM THE INDIAN OCEAN



PONTONIINÆ FROM THE INDIAN OCEAN



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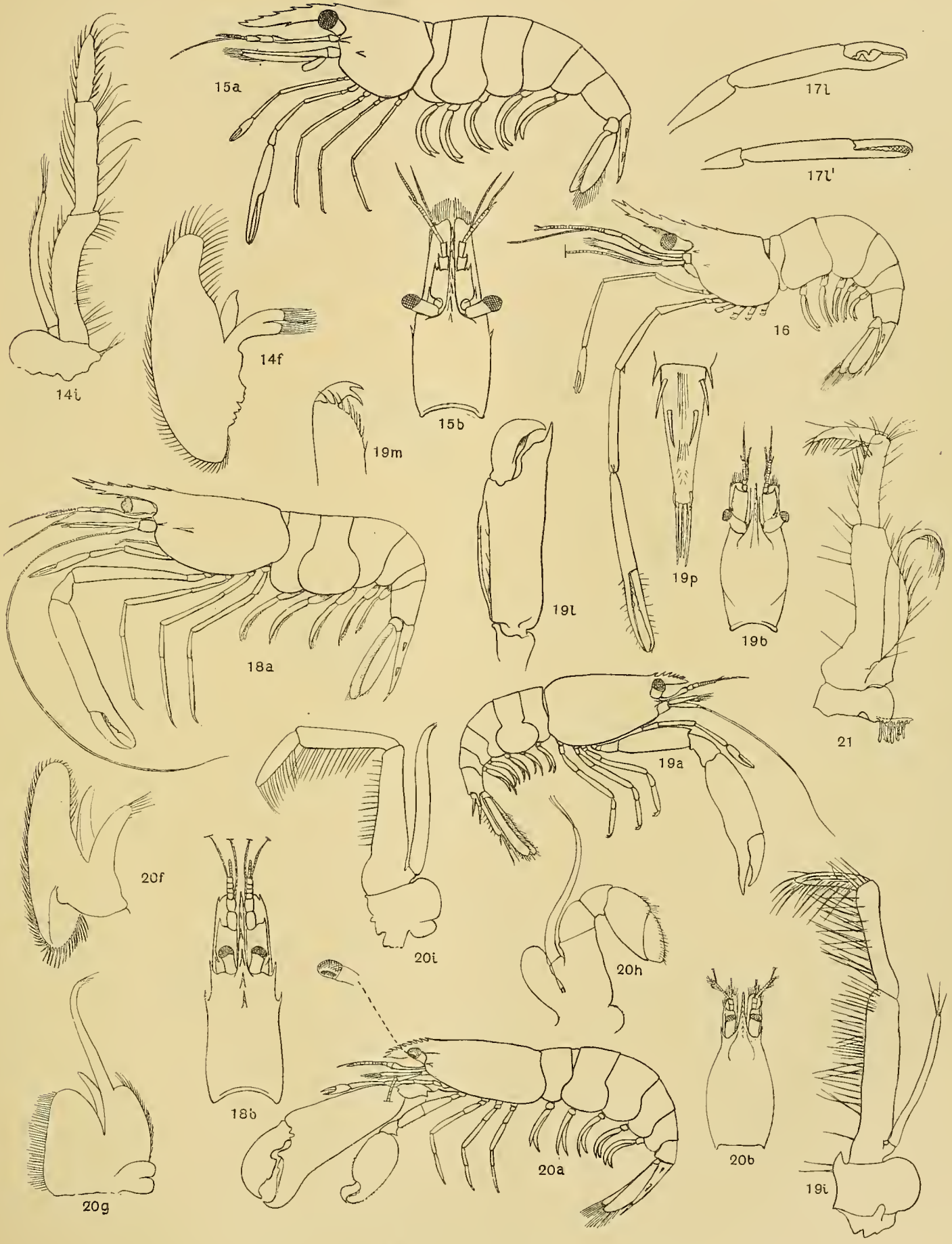

PONTONIINÆ FROM THE INDIAN OCEAN

PONTONIINÆ FROM THE INDIAN OCEAN

PONTONIINÆ FROM THE INDIAN OCEAN

No. IX.—ON CARIDES FROM THE WESTERN INDIAN OCEAN.

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(Communicated by Prof. J. Stanley Gardiner, M.A., F.R.S., F.L.S.)

(Plates 58, 59.)

Read 2nd November, 1916.

The prawns which are enumerated in this paper are the residue of several large collections, a great part of which has already been described elsewhere. They were gathered by Professor J. Stanley Gardiner's two expeditions to the Islands and Banks of the Western Indian Ocean, and by Mr J. C. Fryer in Aldabra. I have dealt with the Ponæides and Stenopides of these collections in an article in the Transactions of this Society which appeared in February 1910 ((2) Zool. xiii. pt. 2, p. 257), and with the freshwater Carides in other articles in the same publication ((2) Zool. xii. pt. 1, p. 63, and xiii. pt. 3, p. 405) and in Gardiner's Fauna of the Maldives (vol. i. p. 64). The Alpheidæ have been reported upon by Professor Coutière in Gardiner's Fauna of the Maldives (vol. ii. p. 852) and in the present volume, and the Pontoniidæ by myself, also in this volume (pp. 323—396). Only 26 species remain to be dealt with here, but these are by no means the least important part of the collections. Twelve of them were new to science, including one for which it has been necessary to found a new genus*, and there is an exceptionally large proportion of interesting forms. The common but remarkable species *Saron marmoratus* is of course included, and this allows me to make some remarks concerning Mr Kemp's recent discoveries with regard to the seeming dimorphism of the males, to which I first called attention in the year 1898. There is a new species of the genus *Thor*, hitherto only known to contain *T. paschalis* (Heller). The rare *Ligur uveæ*, hitherto only known by the specimens described by myself from the Loyalty Islands, has reappeared, and I am enabled to add some details to my original description. *Lysmatella* is a new genus related to *Hippolysmata* but, somewhat strangely, unprovided with mastigobranchs upon the legs. The specimens which I have referred to *Leander debilis* throw some light upon the meaning of the great variability of this species and upon the nature of the numerous forms related

* Short definitions of the new species and of the new genus have already appeared in the Annals and Magazine of Natural History for February, 1915.

to it, showing that we have here quite possibly a number of distinct local races—a rare phenomenon among Carides. *Nikoides maldivensis* is a second representative of a genus which has not been met with since it was described in Paulson's well-known but for a long time inaccessible paper on the Decapoda of the Red Sea. Lastly, a study of the species of *Amphipalæmon*, *Hymenocera*, and *Gnathophyllum* has elucidated the relationships of these very interesting and remarkable genera, and necessitated a very considerable rearrangement of families in the neighbourhood of the Crangenoida. There is, indeed, no exaggeration in saying that the result of the examination of this little collection will be to bring about fundamental alterations in our ideas of the affinities of the higher families of the Carides.

It is unfortunately not possible at present to draw any conclusions concerning the geographical distribution of the Indopacific prawns.

The following is a list of the species, with comments upon facts of interest concerning them.

Superfamily Pasiphæoida.

Family Pasiphæidæ.

Genus Leptochela.

1. *Leptochela robusta* Stimpson, 1860.

Proc. Acad. Philadelphia, 1860, p. 43. de Man, Abh. Senckenb. Ges. xxv. III. p. 902 (1902).

Haddumati Atoll, Maldive Is.

Superfamily Pandaloida

Family Pandalidæ.

Subfamily Pandalinæ.

Genus Pandalus.

Subgenus Plesionika.

2. *Pandalus* (*Plesionika*) *gracilis* Borradaile, 1915 (Plate 58, fig. 1).

Ann. Mag. Nat. Hist. (8), xv. p. 208.

Diagnosis: The *rostrum* is long (its tip appears to be damaged in the specimen) and of even width throughout. At its base two strong teeth stand above the eye on a crest which extends backwards over the first half of the carapace. The rostrum itself is gently upcurved from the base; about the hindermost third of its length is unarmed; the rest bears below a series of small sharp teeth, set wider apart towards the tip of the organ, and above eight minute spinules, widely set, the last two being somewhat larger than the rest. The *eye* is wider than its stalk, and has a distinct ocellus. The stalk of the *antennule* is less than the length of the antennal scale. The flagella

of antennule and antenna are broken short in the specimen. The *third maxilliped* reaches more than half-way along the antennal scale. The *first leg* is simple and sparsely hairy and barely falls short of the end of the third maxilliped. The *second leg* reaches the end of the first; its wrist is nine-jointed, the first five joints being longer and less distinct than the rest. The *legs of the last three pairs* are missing from the specimen. The third *abdominal tergum* is convex behind, but not produced into a spine. The sixth abdominal segment is longer than the fourth and fifth together. The telson is missing from the specimen.

Length of specimen from tip of rostrum to tip of uropods 49 mm.

The species appears to be related to *P. martius* A. M.-Edwards, 1883, and *P. ensis*, (A. M.-Edwards), 1881.

A single female specimen was taken at a depth of 200 fathoms in the Western Indian Ocean.

Genus Heterocarpus.

3. *Heterocarpus unicarinatus* Borradaile, 1915 (Plate **58**, fig. 2).

Ann. Mag. Nat. Hist. (8), xv. p. 208.

A specimen taken in 637—665 fathoms near Providence Island is closely related to *H. longirostris* MacGilchrist, 1905 [Ann. Mag. N. H. (8), xv. p. 237] but distinguished by the loss of the hinder three-quarters of the antennal carina, of which the forepart is present though not sharply formed. The specimen is a good deal damaged, and may have presented other differences from *H. longirostris*. It measures 92 mm. to the tip of the rostrum, which is broken. Provisionally, at least, it deserves specific recognition.

4. *Heterocarpus affinis* Borradaile, 1915.

Ann. Mag. Nat. Hist. (8), xv. p. 208.

Specimens taken in 300—500 fathoms near Saya de Malha are nearly related to *H. alphonsi* Bate, 1888, but show the following points of difference: (1) the *rostrum* is much more strongly upcurved, and has three teeth on the carapace behind the orbit, (2) there are fewer joints in the wrists of the *second legs* (26 and 9, as against 40 and 11), (3) the *walking legs* considerably outreach the antennal scale. The *telson* bears five pairs of spines on the dorsal surface and three pairs at the end. The longest specimen is 12 cm. in length, including the rostrum.

Subfamily Thalassocarinæ.

Genus Thalassocaris.

5. *Thalassocaris crinitus* (Dana), 1852.

Regulus crinitus, Dana, U. S. Explor. Exped. Crust i. p. 599; Atlas, Pl. 39, fig. 6.

The rostrum of this species may be somewhat longer than in the specimen figured by Dana, and the rostral formula varies within the limits $\frac{8-10}{2-3}$.

Specimens were taken in various depths down to 80 fathoms at Amirante I. Cargados Carajos, the Maldives, Saya de Malha, and the Seychelles.

6. *Thalassocaris affinis* Borradaile, 1915 (Plate 58, fig. 4).

Ann. Mag. Nat. Hist. (8), xv. p. 208.

Diagnosis: The species is closely related to *T. lucidus* (Dana), 1852, but differs from it in the following points: the *rostrum* is less strongly upcurved, and is usually rather shorter. Its formula is $\frac{8-10}{2-3}$. The "teeth" on the *antennal scale* are hooked thorns, stronger than in *T. lucidus* and set wider apart. The hands of the *second legs* are of the shape of *T. crinitus*—rectangular, with widely gaping fingers and a strong basal knob on the fixed finger, and a stout tooth on the moveable finger. The merus in the *walking legs* bears the stout thorns present in *T. crinitus* but neither mentioned nor figured by Dana for *T. lucidus*.

Length of the longest specimen 25 mm.

Many of the specimens are mature, and some of them are considerably larger than the smaller specimens of *T. crinitus*. *T. affinis* appears to be intermediate between *T. lucidus* and *T. crinitus*. It was taken at various depths down to 26 fathoms in the Maldives and at Saya de Malha.

7. *Thalassocaris maldivensis* Borradaile, 1915 (Plate 58, fig. 5).

Ann. Mag. Nat. Hist. (8), xv. p. 208.

Diagnosis: The *body* is stout and compressed. The *rostrum* outreaches the antennal scale, at first descends and then is horizontal, and has the formula $\frac{7-8}{2}$, two of the dorsal teeth standing behind the orbit with sometimes a vestigial tooth behind the first of them. Suborbital and antennal, but no supraorbital or hepatic *spines* are present. The *antennal* stalk is slightly outreached by the antennular, and extends to about one-third of the length of the *antennal scale*, which is without teeth on the outer edge. The *third maxilliped* nearly reaches the end of the antennal scale. The *first leg* ends at the middle of the last joint of the third maxilliped. The *second* leg outreaches the third maxilliped and has a small chela of simple form, the wrist about as long as the arm, and the fingers shorter than the palm. The *legs of the last three pairs* are sparsely hairy and of moderate length and stoutness. The abdominal *pleura* are sharp pointed. The *third abdominal somite* has no spine on its hinder edge. The *telson* is longer than the uropods and has four pairs of dorsal spines and two fixed terminal spines.

Length of the longest specimen 19 mm.

Peculiar features of the species are the absence of the spine on the third abdominal segment and of the supraorbital spines, and the feebleness of the second leg. The first maxilliped differs greatly from that figured by Dana for *T. lucidus*, but the latter was probably drawn from a damaged specimen.

Specimens were taken in Suvadiva, Mulaku, Haddumati, and S. Nilandu Atolls in the Maldives.

Superfamily Palæmonoida.

Family Alpheidæ.

The Alpheid Prawns collected by Professor Gardiner's Western Indian Ocean Expedition form the subject of a separate report by Prof. Coutière in this volume.

Family Hippolytidæ.

Genus Saron.

8. *Saron marmoratus* (Olivier), 1811.

Palæmon marmoratus, Olivier, Encycl. viii. (*fide* H. M.-Edwards).

Hippolyte gibberosus and *H. marmoratus*, H. M.-Edwards, H. N. Crust. ii. pp. 378, 379, Pl. 25, fig. 8 (1837).

Hippolyte gibberosa and *H. marmorata*, de Man, Arch. Naturg. liii. i. p. 533 (1888).

Saron marmoratus, Borradaile, Proc. Zool. Soc. Lond., 1898, p. 1009 ; Kemp, Rec. Ind. Mus. x. p. 84 (1914).

The rest of the synonomy of *S. marmoratus* will be found in the last two papers quoted.

Kemp (*loc. cit.*) has shown that the relation of the two forms of the male of this species is not, as I had formerly suggested, a true dimorphism, since the individuals do not fall into two well-defined groups but form a graded series. This does not appear either in the present specimens, which are *all* of the *gibberosus* type, or in those which served as the basis of my earlier remarks upon the subject, in which there were two sharply-defined groups. I have, however, no doubt that Mr Kemp's solution of the question is the correct one, and that the *marmoratus* characters are gradually assumed by the males with age.

The collection contains 28 specimens from Salomon, Amirante, the Maldives, Minikoi, and Coetivy, Seychelles.

9. *Saron neglectus* de Man, 1902.

Abh. Senckenb. Ges. xxv. p. 854, Pl. 26, fig. 58. Kemp, Rec. Ind. Mus. x. p. 87 (1914).

One specimen from Egmont Reef, Seychelles.

Genus Ligur.

10. *Ligur uveæ* (Borradaile), 1902.

Parhippolyte uveæ, Borradaile, Willey's Zool. Results, p. 414, Pl. 38, figs. 11 *a*—*g*.

Ligur uveæ, Kemp, Rec. Ind. Mus. x. p. 123 (1914).

The original description of this species omits the fact that the meropodites of the legs of the second pair, and the propodites of those of the last three pairs, are multiarticulate.

Numerous specimens from Aldabra.

Genus Thor.

11. *Thor maldivensis* Borradaile, 1915 (Plate 58, fig. 6).

Ann. Mag. Nat. Hist. (8), xv. p. 208.

Diagnosis: The *body* is moderately compressed. The *carapace* is short, not keeled, and has large supraorbital and small antennal spines. The *third abdominal segment* projects in the middle behind. The *rostrum* is very short, not reaching the end of the

first joint of the antennular stalk, its tip is simple, and it bears one tooth above at the level of the eye and none below. The *antennular stalk* is a little shorter than the antennal, its last two joints are very short and broad, and it bears a strong spine on each joint, those on the first two joints being sharp and external and the third broad, dorsal, and sutured. The *antennal stalk* is nearly half the length of the scale. The latter reaches nearly as far as the stouter flagellum of the antennule, has a convex inner edge, a straight outer edge, and a rounded end, and bears on the outer side a distal spine, which does not project as far as the end. The *third maxilliped* is strong, and outreaches the antennal scale in the male by more and in the female by less than the whole of the last joint. The last and antepenultimate joints are subequal, each more than twice as long as the penultimate joint, the last joint is spinous, and all the joints are hairy. The *first leg* in the female is stout, simple, and shorter than the third maxilliped. In the male, it is as long as the body, granulate, and stout, but with the chela no stouter than the rest of the limb, the arm and hand are subequal, and the fingers about one quarter the length of the palm, on which they are bent inwards at an obtuse angle, each bearing a low tooth. The *second leg* has the wrist 5-jointed, with the second joint much longer than any of the others and showing an indistinct ring near its proximal end. The *legs of the last three pairs* are alike in the two sexes, of medium length, with a blunt spine at the end of the carpopodite, a row of spinules under the propodite, and the dactyle short, stout, ending in a slender claw, and bearing below several moveable spinules of which the last is longer than the end claw. The *telson* is shorter than the uropods, narrow, and tapers to an obtusely triangular end bearing six spines, of which the intermediate pair are the longest.

Length of longest specimen 13 mm.

The genus *Thor* has hitherto contained only one known species, *T. paschalis* Heller 1861 (*T. floridanus* Kingsley). The present species has all the characters of the genus, including those of the mandible, but the great claw of the male is a new feature. The principal differences from *T. paschalis* are presented by the supraorbital spine, the rostrum, the first and third legs of the male, and the proportions of the joints of the second leg.

Specimens were taken at Malé Atoll in the Maldives, in Minikoi, and at Salomon I.

Genus Tozeuma.

12. *Tozeuma armatum* Paulson, 1875.

Red Sea Crustacea, p. 99, Pl. 15. figs. 2*a*—*o*. Kemp, Rec. Ind. Mus. x. p. 106 (1914).

Specimens were taken in various depths in the Maldives, the Seychelles, and Cargados Carajos.

Genus Lysmata.

13. *Lysmata affinis* Borradaile, 1915.

Ann. Mag. Nat. Hist. (8) xv. p. 209.

Diagnosis: a *Lysmata* closely related to *L. seticauda* (Risso), 1816, and to *L. chiltoni* Kemp, 1914, but distinguishable from them and from the other species of the genus

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by the following combination of features: the *rostrum* reaches well beyond the eyes, but ends just before the middle of the second joint in the antennular stalks. Its formula is $\frac{5-6}{2-3}$, the lower teeth being small, but larger than in *L. chiltoni*, and the hinder of them standing below the last upper tooth. The *pterygostomial angle* is rectangular and usually produced into a spinule. The *thick flagellum* of the antennule is fused to the slender one for half its own length. The *antennal scale* curves gently outwards and narrows slightly towards the end, which is truncate and distinctly outreached by the distal spine, the *first leg* slightly outreaches the scale but falls considerably short of the end of the third maxilliped. The wrist joint is as long as, usually a trifle longer than, the chela. The *second legs* are equal or unequal. The longer of the pair outreaches the antennal scale by rather less than the whole wrist. The latter has 24—25 joints. There are double tips to the fingers. The *walking legs* have spinules below the meropodites. The first outreaches the antennal scale by the dactyle and nearly the whole propodite, the second by the propodite only, and the third falls a little short of the end of the scale.

Length of the longest specimen 31 mm.

Specimens were taken in Minikoi, Peros Banhos, Salomon, and the Seychelles.

Genus Hippolysmata.

14. *Hippolysmata vitatta* Stimpson, 1860.

Proc. Acad. Philadelphia, 1860, p. 26. de Man, Trans. Linn. Soc. London, (2) Zool. ix. p. 423 (1907). Kemp, Rec. Ind. Mus. x. p. 113 (1914).

Specimens were taken at Cargados Carajos in 30 fathoms, and in the Seychelles in 34 fathoms.

15. *Hippolysmata kükenthali* (de Man), 1902.

Merhippolyte orientalis, de Man (*nec* Bate), Weber's Zool. Ergebn. Reise Ost-Ind. ii. p. 407.

Hippolyte kükenthali, de Man, Abh. Senckenb. Ges. xxv. p. 849, Pl. 26, fig. 56 (1902).

Hippolysmata kükenthali, de Man, Trans. Linn. Soc. London, (2) Zool. ix. p. 426 (1907). Kemp, Rec. Ind. Mus. x. p. 115 (1914).

Ten specimens were taken on Egmont Reef, Seychelles. Each has a single tooth on the underside of the rostrum, and 14 or 15 joints in the wrists of the second legs.

Genus Lysmatella.

Borradaile, Ann. Mag. Nat. Hist. (8), xv. p. 206 (1915).

The collection contains three specimens of a new species which would have to be placed in the genus *Hippolysmata*, were it not for the absence of epipodites from the legs. In view of this somewhat important difference I have thought it best to establish for this species a new genus *Lysmatella*.

16. *Lysmatella prima* Borradaile, 1915 (Plate 58, fig. 7).

Ann. Mag. Nat. Hist. (8), xv. p. 209.

Diagnosis: The *body* is compressed, the carapace of a good length, keeled in the forepart and provided with a strong antennal and a small pterygostomian spine. The *rostrum* is straight at first but gently upcurved towards the tip, outreaches the antennular stalk, and has the formula $\frac{8-11}{5-9}$, the first tooth standing detached on the carapace, the ventral teeth smaller than the dorsal, and all the teeth sloping very sharply forwards. The rostrum becomes relatively longer and more strongly curved as the individuals increase in size. The *antennule* has a long, slender stalk, and the stylocerite short, wide and curved. The *antennal scale* reaches the end of the penultimate joint of the antennular stalk, and is narrow, with nearly parallel sides and a broad, rounded end. The *third maxilliped* is as stout as the *first leg*, in which the hand and arm are subequal, the wrist a little shorter than either, and the fingers gape somewhat widely. In the *second leg* the wrist has 20—22 joints, of which the last is longer than any of the others. The dactyles of the *walking legs* are provided, besides the end-claw, with three moveable spines on the lower side, and of these the third is larger than the end-claw. The *telson* is barely shorter than the uropods, bears two pairs of moveable spines above, and is fringed with long, stout hairs.

Length of the longest specimen 19 mm.

Specimens were taken in Haddumati, Mulaku, and South Nilandu Atolls, Maldives.

Family Palæmonidæ.

Subfamily Palæminæ.

Genus Leander.

17. *Leander debilis* (Dana), 1852.

Palaemon debilis, Dana, U. S. Explor. Exped. xiii. i. (Crust.), p. 585, Pl. 38, figs. 6—7. de Man, Abh. Senckenb. Ges. xxv. iii. p. 808 (1902).

The collection contains a large number of specimens of *L. debilis* from Aldabra which show the great variability which characterizes this species. The rostrum varies in length, shape, and dentation. It may be as long as, shorter than, or longer than the antennal scale. Its curves differ considerably in the specimens. Its formula in these examples is $\frac{2-6}{1-6}$, most commonly $\frac{5}{4}$, including the small tooth which is nearly always present near the tip. The size, shape, and spacing of the teeth varies. The wrist of the second leg varies in length, but usually falls a little short of the end of the antennal scale. The antennule agrees with de Man's description.

There are also a number of specimens from a "barachois" in Diego Garcia. These are less variable than the Aldabra specimens. The rostral formula is $\frac{4-8}{4-8}$, usually $\frac{6}{6}$. The average size is less than that of the Aldabra specimens, the largest specimen measuring 28 mm. in length. It is quite possible that we have here two distinct but closely allied species, such as the *L. debilis* and *L. gardineri* found in

Miladumadulu Atoll (Gardiner's Fauna of the Maldives, i. p. 98). In the case of the Miladumadulu species the habits and appearance of the prawns in the living state enabled the two forms to be distinguished with certainty. Possibly similar information would avail in the same way here.

Subfamily Pontoniinæ.

Many species of this subfamily are represented in the collection. They are enumerated in a separate article in this volume (pp. 323—396).

Superfamily Crangonoida.

The bounds of this somewhat miscellaneous group must be enlarged to admit the genera *Anchistioides*, *Amphipalæmon*, and *Hymenocera*, which, in our present state of knowledge appear more closely related here than elsewhere. This addition involves two concessions in the definition of the group: (1) if *Anchistioides* and *Amphipalæmon* are to be admitted, it can no longer be stated that the mandible is always without incisor process, (2) the inclusion of *Hymenocera* makes it necessary to allow the persistence of a small representative of the second lobe of the maxilla.

Family Anchistioididæ.

Borradaile, Ann. Mag. Nat. Hist. (8), xv. p. 205 (1915).

In 1899, reporting on the Macrura brought by Dr A. Willey from the South Seas, I established a genus *Palæmonopsis* for a new prawn, *P. willeyi*, taken in New Britain. In 1901, Nobili proposed to change the name of this genus to *Amphipalæmon*, on the ground that *Palæmonopsis* was preoccupied, having been used by Stimpson as a synonymn of *Palæmonetes*. Both by Nobili and by myself the genus has been regarded as belonging to the Palæmonidæ.

The present collection contains two specimens, each representing a new species of *Amphipalæmon*. Examination of these, and re-examination of Dr Willey's original specimen, convinces me (1) that the characters of the new genus are so distinctive that it must become the type of a new family, (2) that the affinities of this family are at least as much with the Crangonoida as with the Palæmonoida, (3) that the genus *Anchistioides* founded by Paulson in 1875 is closely related to *Amphipalæmon*.

The characters of the Anchistioididæ may be stated as follows:

(1) The *body* retains the typical caridoid facies.

(2) The *rostrum* is well developed, compressed, and toothed.

(3) There is no *supraorbital spine*, but there may be a blunt knob nearly in the same position.

(4) The outer flagellum of the *antennula* bears at the base a short, thick, accessory flagellum. The stylocerite is inconspicuous or wanting.

(5) The *antenna* has a broad scale, truncate at the end, and is without a spine on its basipodite.

(6) The *mandible* is deeply cleft, the molar process has a broad end, surrounded with stout teeth, the incisor process is coarsely serrate, and there is no palp.

(7) The inner lacinia of the *maxillule* is round-ended, and not curved towards the outer lacinia.

(8) The laciniae of the *maxilla* are aborted.

(9) The exopodite of the *first maxilliped* has no flagellum, and its epipod is simple.

(10) The end-joint of the *second maxilliped* is applied to the inner edge of the recurved propodite. The epipodite of this limb is discoidal.

(11) The *third maxilliped* is slender, and has no exopodite, but a short broad epipodite.

(12) The *legs of the first two pairs* are without exopodites, chelate, with simple wrists, and subsimilar, but the second pair is longer and stouter than the first.

(13) The *legs of the last three pairs* are alike, without exopodites and adapted for walking.

(14) The *first five abdominal limbs* have a well-developed *appendix interna*, and in the first of them, especially in that of the male, the endopodite is small, so that it forms with the *appendix* a biramous organ.

(15) The *telson* bears two or three pairs of spines above, and at the end one strong pair of spines and several stout bristles, of which one or a pair are feathered.

(16) The *gills* comprise pleurobranchs for the legs and an arthrobranch for the third maxilliped. There are epipodites on the maxillipeds only.

The family appears to be transitional between the Palæmonoida and the Crangonoida.

The genera of Anchistioididæ may be distinguished as follows:

I. Without a blunt process of the carapace behind the eye. Scaphocerite present. The end of the telson bears, among others, one unfeathered bristle on each side and a pair of small lateral spines.

Anchistioides Paulson, 1875.

II. A blunt process of the carapace behind the eye. No scaphocerite. The end of the telson bears, among others, more than one unfeathered bristle on each side at the end of the telson, but no small lateral spine.

Amphipalæmon Nobili, 1901.

Genus Amphipalæmon.

The species of *Amphipalæmon* are closely similar in most respects, but may be distinguished as follows:

I. Three pairs of spines on the dorsal side of the telson, and a median feathered bristle at the hinder end. Rostrum does not reach end of antennal scale [and is very deep and straight at base].

A. willeyi (Borradaile), 1899.

II. Two pairs of spines on the dorsal side of the telson, and a pair of feathered bristles at the hinder end. Rostrum at least reaches end of antennal scale.

A. Rostrum very deep, straight at base.

A. gardineri Borradaile, 1915.

B. Rostrum not very deep, arched at base.

A. cooperi Borradaile, 1915.

18. *Amphipalæmon gardineri* Borradaile, 1915 (Plate **59**, fig. 14).

Ann. Mag. Nat. Hist. (8), xv. p. 209.

The most important difference between this species and *A. willeyi* lies in the arrangement of the spines of the telson. In the New Britain species, the two anterior pairs of spines on the dorsal side of this organ lie in its front half. In *A. gardineri* the second of them lies just behind the middle of the telson. In *A. willeyi* (Plate **59**, fig. 13), the two small lateral spines of *Anchistioides,* which are also found in so many other Carides, have migrated to the dorsal surface of the telson. In *A. gardineri* they are altogether wanting. In the latter species, the adjoining spines, which thus become lateral, are longer than in *A. willeyi.* The pair of feathered bristles found in *Anchistioides* are present also in *A. gardineri*; in *A. willeyi* they are absent, but there is present a single median feathered bristle, shorter than those of *A. gardineri* and widened at the base.

Lastly, in *A. willeyi* there are a number of unfeathered bristles, of which three on each side are somewhat shorter than the rest. In *A. gardineri* only two such bristles are present.

Less important differences, which may quite possibly prove not to be constant, are: (1) that the rostrum has the formula $\frac{7}{3}$ and outreaches the antennal scale, and (2) that the first leg does not reach the end of the antennal scale, and (3) that the second leg outreaches the scale by only half the length of the palm, and its meropodite is relatively shorter.

The specimen, which measures 30 mm. in length, was taken in N. Malé Atoll.

19. *Amphipalæmon cooperi* Borradaile, 1915.

Ann. Mag. Nat. Hist. (8), xv. p. 209.

This species very closely resembles the preceding, but differs from it in the following points: (1) the rostrum has the formula $\frac{6}{3}$, barely outreaches the antennal scale, and is arched at the base and decidedly less deep, (2) the first leg reaches the end of the antennal scale, (3) the second leg outreaches the scale by the whole hand, (4) the

meropodite of this leg is longer than in either of the other species, equalling $\frac{6}{7}$ of the length of the hand, (5) the hinder pair of the dorsal spines of the telson lies farther back than in *A. gardineri*.

Length of single specimen 15 mm.

S. Nilandu Atoll.

Family Gnathophyllidæ.

Professsor Gardiner's collection contains specimens of members of the genera *Gnathophyllum* and *Hymenocera* and also of the very interesting species described by Dr Balss as *Hymenocera ceratophthalma*. An examination of this material makes it quite clear that the species in question are all members of a single family. The principal characters of this family are as follows:

(1) The body retains the typical caridoid facies, but is rather heavily built.

(2) The *rostrum* is compressed and dentate.

(3) The *antennal spine* alone remains on the carapace.

(4) The *antennule* has a well-developed stylocerite, and the outer flagellum thick at the base and cleft for a very short distance at the end of the thick part.

(5) In the *antenna* the scale may be broad or rather narrow, and is rounded at the end, and the spine of the basipodite is short or absent.

(6) The *mandible* is simple, palpless, slender, and curved.

(7) The inner lacinia of the maxillule is pointed and curved towards the outer lacinia.

(8) The first lobe of the *maxilla* is totally lost and the second lobe is either lost or very small but still obscurely double.

(9) The *first maxilliped* has a flagellum and the outer border of its epipodite is notched, but not deeply.

(10) The end-joint of the *second maxilliped* is applied to the inner edge of the recurved propodite.

(11) The *third maxilliped* has an exopodite, a simple epipodite, and an endopodite of four joints, some or all of which are greatly broadened.

(12) The *legs of the first two pairs* are chelate, without exopodites and with simple wrists. The two pairs are more or less dissimilar, and the second pair is the larger.

(13) The *legs of the last three pairs* are alike, without exopodites, and adapted for walking.

(14) The *second to fifth abdominal limbs* have a well-developed *appendix interna*.

(15) The *telson* bears two pairs of spines at the sides, and at the end an outer short and an inner longer pair of spines, a submedian pair of slender feathered spines, and a median pointed projection.

(16) The *gills* comprise pleurobranchs for the legs, an arthrobranch for the third maxilliped, and in *Hymenocera* the vestige of a pleurobranch for the latter limb. There are epipodites on the maxillipeds only.

A key to the genera of Gnathophyllidæ:

I. Ischium of third maxilliped narrow and moveably sutured to merus. Rostrum of a good length.

A. Mandible flattened. Lobe of maxilla present. Outer flagellum of antennule leaf-like.

Hymenocera Latreille, 1829.

B. Mandible subcylindrical. Lobe of maxilla lost. Outer flagellum of antennule normal.

Phyllognathia Borradaile, 1915.

II. Ischium of third maxilliped broad and marked off from merus by a notch only. Rostrum short.

[Mandible, maxilla and antennule as in Phyllognathia.]

Gnathophyllum Latreille, 1829.

Genus Gnathophyllum.

20. *Gnathophyllum fasciolatum* Stimpson, 1860 (Plate **59**, fig. 8).

Proc. Ac. Philadelphia, 1860, p. 28. de Man, Arch. Naturg. liii. i. p. 496 (1888). Abh. Senckenb. Ges. xxv. iii. p. 762 (1902).

Gnathophyllum zebra, Richters, Meeresf. Mauritius, p. 161, Pl. 17, figs. 18—20 and 22 (1880).

All the specimens are completely bleached. A small antennal spine which is present in my specimens is not mentioned in any description of the species.

According to Nobili (Mem. Ac. Torino (2), lvii. p. 305), this species is identical with *G. americanus*, and should be known by that name.

Specimens were taken at Minikoi, Salomon I., and Egmont Reef, Seychelles.

Genus Phyllognathia.

21. *Phyllognathia ceratophthalma* (Balss), 1914 (Plate **59**, fig. 9).

Hymenocera ceratophthalma, Balss, Abh. k. Bayer. Ak. Wiss. Suppl. Bd. ii. 10, p. 54 (1914).

Phyllognathia ceratophthalma, Borradaile, Ann. Mag. Nat. Hist. (8), xv. p. 206 (1915).

Dr Balss has kindly communicated to me his opinion that this species is in reality a *Gnathophyllum*. Its transference to the Gnathophyllidæ will probably meet with approval, but in including it in *Gnathophyllum* some rather considerable differences between its mouth-parts and those of other species of the genus have to be discounted. In the third maxilliped of *Gnathophyllum*, the ischiopodite is fused with the meropodite,

though, by an exception to the rule in Carides, the boundary between these two joints is marked by a notch. In *H. ceratophthalma* the ischiopodite is distinct and even moveably articulated with the meropodite, a condition which I cannot remember to occur in any other Caridean except *Hymenocera*. In the second maxilliped of *G. fasciolatum* (the only species I have been able to examine), the last two joints form a very large scythe-shaped organ. In *H. ceratophthalma* they are rather smaller than in most Carides. Finally, in the maxillule of *G. fasciolatum* the outer lacinia is greatly enlarged, while in *H. ceratophthalma* it is of quite normal dimensions. In the characters of the second maxilla and mandible, however, *H. ceratophthalma* agrees very well with *Gnathophyllum*. Both the lobes of the maxilla are lost, and the mandible is simple, without palp, and of a slender, curved shape, with a blunt end provided with small teeth. I would suggest that it is advisable to establish a new genus of Gnathophyllidæ for Dr Balss's species. *Phyllognathia* would be an appropriate name for this species, which undoubtedly links *Hymenocera* with *Gnathophyllum*.

In Dr Balss's specimen the smaller leg of the second pair and the tip of the rostrum were missing. My specimen enables me to state that the rostrum slightly outreaches the antennular stalks and has the formula $\frac{7}{4}$, and that the smaller leg of the second pair has the same features as the larger but a somewhat narrower palm and less pronounced serration of the moveable finger. The larger leg of this pair is missing in my specimen; which was taken in S. Nilandu Atoll.

Genus Hymenocera.

The mandible of *Hymenocera* is of the same shape as that of *Gnathophyllum* save that it is flattened and ends in a serrated cutting edge, as though it represented the incisor process of the complete malacostracan mandible. In point of fact, however, there can be little doubt that it is really the molar process. The maxilla has a small outer lobe, which, however, retains traces of a notch. The telson is of precisely the same type as that of *Gnathophyllum*. The telson of *Crangon* is of the same type but more elongate. That of the Processidæ is more like those of the Pontoniinæ. The telson of *Glyphocrangon* is a much modified structure which has lost all spines.

22. *Hymenocera elegans* Heller, 1861 (Plate **59**, fig. 10).

Verh. zool. bot. Ges. Wien, xi. p. 25; Sitzber. Ak. Wiss. Wien, xliv. 1. p. 264, Pl. 3, figs. 9—14 (1861). Ortmann, Speng. Zool. Jahrb. Syst. v. p. 511, Pl. 37, fig. 11.

A specimen was taken in Coetivy, Seychelles.

Family Processidæ.

Genus Processa.

23. ? *Processa processa* (Bate), 1888.

Nika processa, Bate, "Challenger" Macrura, p. 527, Pl. 95 (1883).

A specimen from the Seychelles which probably belonged to this species was unfortunately destroyed by an accident while it was under examination.

Genus Nikoides.

24. *Nikoides maldivensis* Borradaile, 1915 (Plate **58**, fig. 11).

Ann. Mag. Nat. Hist. (8), xv. p. 209.

A single specimen, taken at the Amirante Is., is closely related to *N. danae* Pauls., 1875 (Res. Crust. Red Sea i. p. 98, Pl. 14, fig. 5), but differs from it in the following points: (1) the rostrum is of a different shape, the dorsal tooth being larger and placed much farther back, (2) the exopodite of the first leg is relatively shorter, reaching only half-way along the merus, (3) the carpopodites of the legs of the first pair are of equal length, (4) there are no spines on the ischium or merus in the legs of the last three pairs. The specimen measured 24 mm. in length. To the differences between *Processa* and *Nikoides* stated by Nobili, there should be added the presence in the latter of a single dorsal tooth on the rostrum.

Family Glyphocrangonidæ.

Genus Glyphocrangon.

Subgenus Plastocrangon.

25. *Glyphocrangon* (*Plastocrangon*) *cæca* Wood-Mason, 1891.

Ann. Mag. Nat. Hist. Nov. 1891, p. 358; Ill. Zool. "Investigator" Crust. Pl. 3, fig. 1.

A single specimen taken in 300—500 fathoms at Saya de Malha.

Family Crangonidæ.

Genus Ægeon.

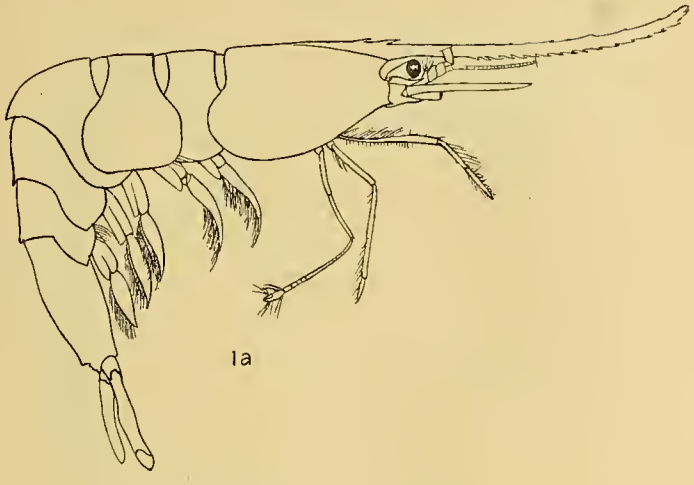
26. *Ægeon rugulosus* Borradaile, 1915 (Plate **59**, fig. 12).

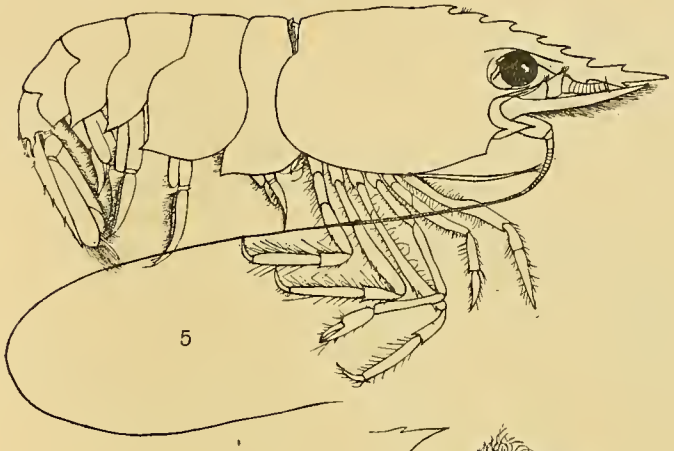
Ann. Mag. Nat. Hist. (8) xv. p. 210.

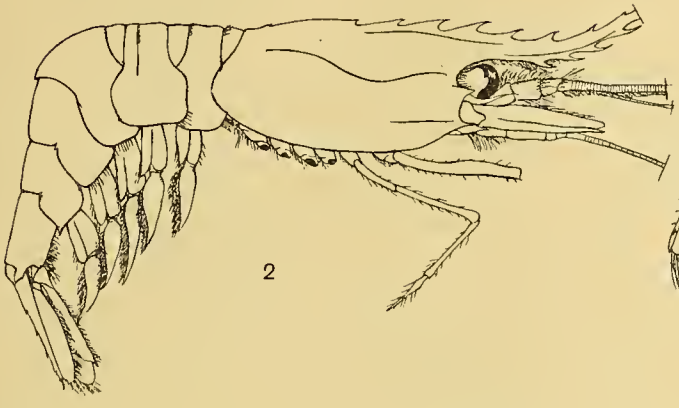
One damaged specimen, taken in Haddumati Atoll, Maldives, is related to *Æ. medius* (Alc. and And.), 1899, but differs from it in that: (1) the beading of the ridges of the carapace is much coarser, (2) there is no tooth on either side of the base of the rostrum, (3) the large spine near the pterygostomial angle of the carapace stands at the end of the supramarginal, not at that of the lateral ridge, (4) the dactyles of the first two walking legs are longer. The length of the specimen is 16 mm.

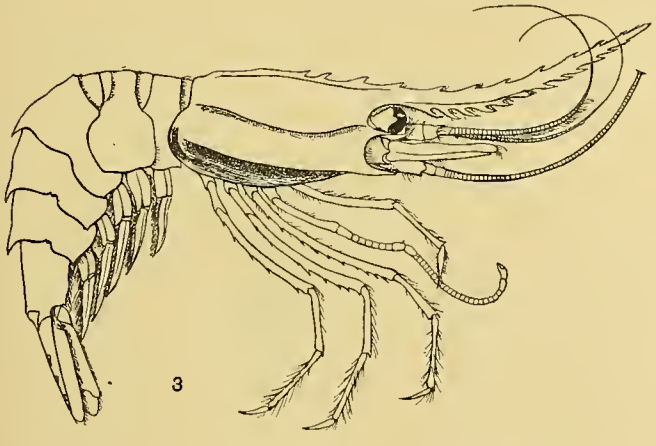
EXPLANATION OF PLATES 58, 59.

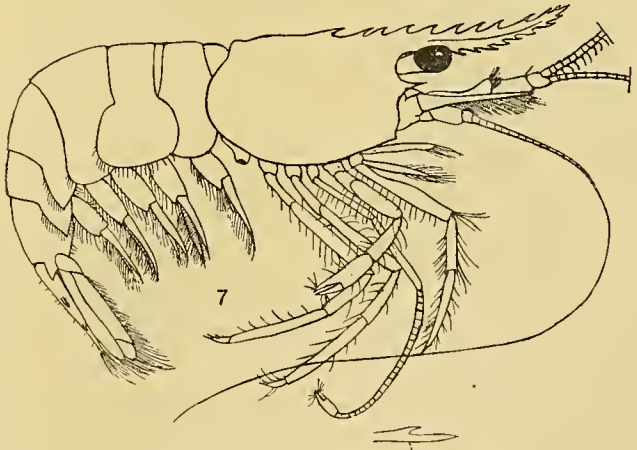
Fig. 1. *Pandalus* (*Plesionika*) *gracilis* Borradaile, 1915 (Plates 58, 59). *a*, side view, × 2½; *b*, end of second leg, × 12.
Fig. 2. *Heterocarpus unicarinatus* Borradaile, 1915 (Plate 58). Side view, × 1½.
Fig. 3. *Heterocarpus affinis* Borradaile, 1915 (Plate 58). Side view, nat. size.
Fig. 4. *Thalassocaris affinis* Borradaile, 1915 (Plate 58). Side view, × 4.
Fig. 5. *Thalassocaris maldivensis* Borradaile, 1915 (Plate 58). Side view, × 4.
Fig. 6. *Thor maldivensis* Borradaile, 1915 (Plate 58). Side view, × 7.
Fig. 7. *Lysmatella prima* Borradaile, 1915 (Plate 58). Side view, × 4.
Fig. 8. *Gnathophyllum fasciolatum* Stimpson, 1860 (Plate 59). *a*, third maxilliped, × 16; *b*, second maxilliped, × 16; *c*, maxillule, × 16; *d*, mandible, × 25.
Fig. 9. *Phyllognathia ceratophthalma* (Balss), 1914 (Plate 59). *a*, third maxilliped, × 16; *b*, second maxilliped, × 16; *c*, first maxilliped, × 16; *d*, maxilla, × 16.
Fig. 10. *Hymenocera elegans* Heller, 1861 (Plate 59). *a*, third maxilliped, × 4; *b*, second maxilliped, × 16; *c*, first maxilliped, × 16; *d*, maxilla, × 16; *e*, maxillule, × 16; *f*, mandible, × 25.
Fig. 11. *Nikoides maldivensis* Borradaile, 1915 (Plate 58). Side view, × 3.
Fig. 12. *Ægeon rugulosus* Borradaile, 1915 (Plate 59). Side view, × 4.
Fig. 13. *Amphipalæmon willeyi* Borradaile, 1899 (Plate 59). Telson, × 35.
Fig. 14. *Amphipalæmon gardineri* Borradaile, 1915 (Plate 59). Telson, × 35.

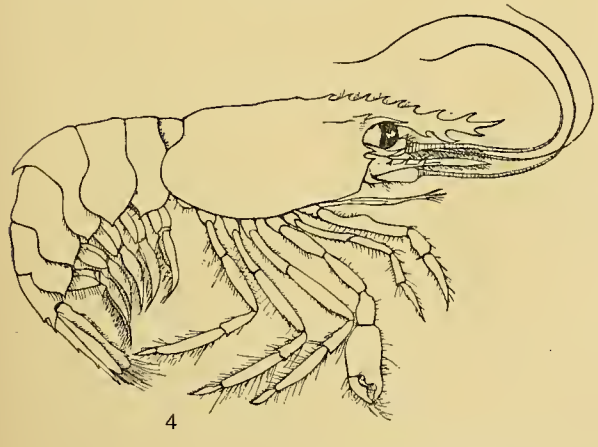


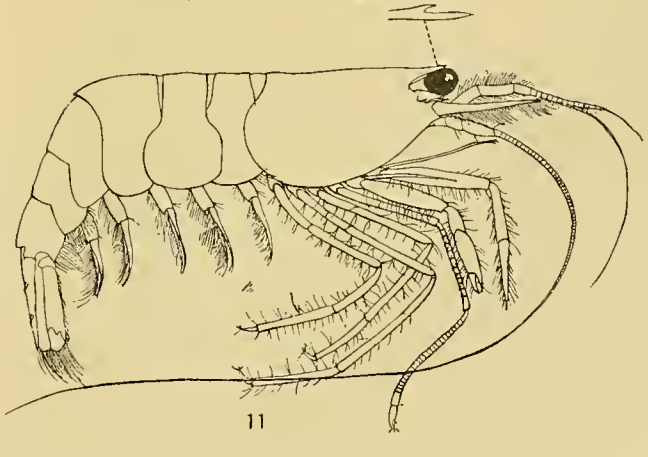




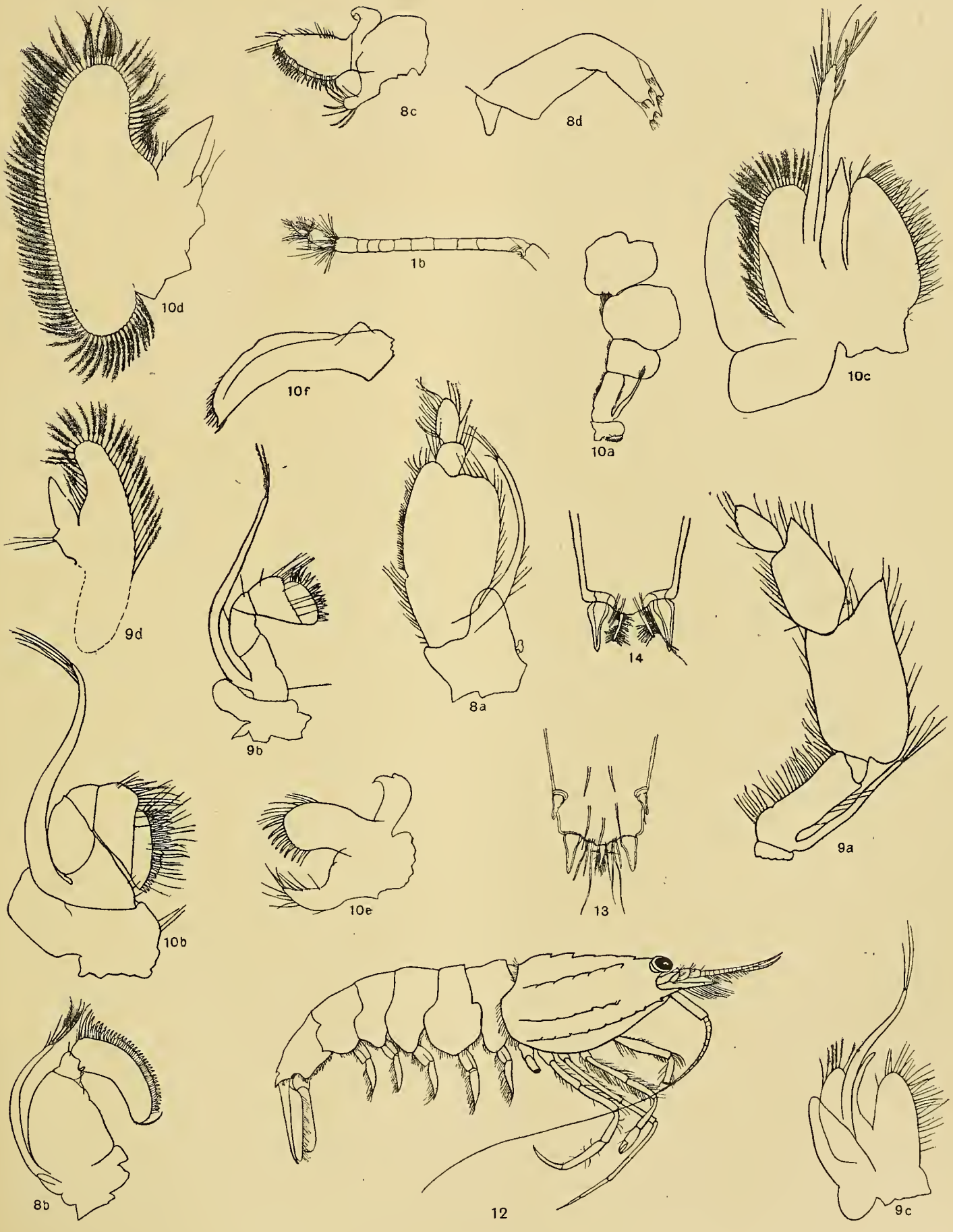








CARIDES FROM THE WESTERN INDIAN OCEAN



CARIDES FROM THE WESTERN INDIAN OCEAN

No. X.—LES ESPÈCES D'ALPHEIDÆ RAPPORTÉES DE L'OCÉAN INDIEN PAR M. J. STANLEY GARDINER.

Par M. le Professeur H. Coutière.

(Communiqué par M. le Professeur J. Stanley Gardiner, M.A., F.R.S., F.L.S.)

(Planches **60**—**64**.)

Lu le 20 Juin, 1918.

MARINE BIOLOGICAL LABORATORY WOODS HOLE LIBRARY MASS.

Les espèces nouvelles d'Alpheidæ rapportées par le Percy Sladen Trust Expédition ont été décrites en 1908, dans le B. de la Soc. Philomathique. Depuis, le très important mémoire de de Man, consacré aux récoltes du Siboga, est venu montrer, surabondamment, quel fonds on peut faire sur les Alpheidæ pour caractériser la faune corallienne d'une région. Et on peut tenir pour certain que la liste est loin d'être close; elle s'allongera encore d'une centaine de formes, au moins, lorsque toute la ceinture corallienne du globe sera aussi bien explorée que l'Indo-Pacifique du Seelark et du Siboga.

Le beau travail de de Man, malheureusement non accompagné des figures si indispensables, m'a obligé à revoir certaines déterminations, en particulier celle du *S. neomeris*, mais, dans l'ensemble, les espèces communes aux deux régions n'ont pas augmenté de nombre, ou à peu près. J'ai donc pu me borner à reproduire, presque textuellement, mon travail de 1908, en y intercalant les espèces déjà connues, et en y ajoutant de nombreuses figures. Ce mémoire est, en somme, la suite de celui que j'ai publié sur les Alpheidæ des Maldives et Laquedives, aussi ai-je pu être très sobre d'indications bibliographiques. Je n'ai pas non plus reproduit les indications des groupes d'espèces, aujourd'hui classiques. Il serait beaucoup plus intéressant de pouvoir dire pourquoi il faut distinguer tant de formes spécifiques dans cette famille à éthologie si spéciale, mais les raisons que j'en aperçois sont beaucoup trop spéculatives pour que je me risque à les donner ici.

Genre *Automate* de Man.

1. *A. salomoni* H. Cout., Bull. Soc. Phil. 1908, p. 2. (Plate **60**, fig. 1.)

L'unique spécimen est une ♀ ovée mesurant 17·5 mm.

Chagos, Salomon Island.

Genre *Athanas* Leach.

2. *A. djiboutensis* H. Cout., Alph. M. et L. p. 856, fig. 129.

Chagos, Egmont récif.

Genre *Arete* Stimpson.

3. *A. indicus* H. Cout., Alph. M. et L. p. 863, figs. 134—35.

Seychelles, Praslin reef.

4. *A. equalis* H. Cout., Alph. M. et L. p. 869, fig. 138.

Coetivy, Amirante Bank, 25—80 brasses.

Genre *Alpheopsis* H. Cout.

5. *A. fissipes* H. Cout., Bull. Soc. Phil. 1908, p. 3. (Plate **60**, fig. 3.)

L'unique spécimen de l'*A. fissipes* est une ♀ de 6·5 mm. de longueur, portant 7 œufs seulement, de taille comparable à ceux de l'*A. equalis*.

Providence, D. 4 (50—78 brasses).

6. *A. idiocarpus* H. Cout., Bull. Soc. Phil. 1908, p. 6. (Plate **60**, fig. 2.)

L'unique spécimen de l'*A. idiocarpus* est un ♂ de 7 mm., provenant, comme le précédent, de Providence, 50—78 brasses.

Ces deux espèces constituent une augmentation de grande importance pour le genre *Alpheopsis*. Jusqu'à présent, ses deux groupes, *equalis* à pinces lisses, et *trispinosus* à pinces sillonnées, paraissent assez faiblement reliés. Peut-être les formes ci-dessus décrites apporteraient-elles précisément le trait d'union cherché, si leurs pinces de la 1e paire étaient connues.

Genre *Synalpheus* sp. Bate.

7. *S. metaneomeris* n. nom. (Plate **60**, fig. 4.)

S. neomeris H. Cout., Alpheidæ des Laquedives et Maldives nec de Man. Bull. Soc. Phil. xi. 5, 1908.

S. streptodactylus de Man, Alpheidæ du Siboga, p. 226.

Dans son magnifique travail sur les Alpheidæ recueillis par l'expédition du Siboga, de Man établit définitivement la non-identité du véritable *S. neomeris* de Man avec l'espèce ci-dessus, qui en est évidemment très distincte. Je ne puis toutefois accepter le nom de *streptodactylus* donné par de Man, le nom correspondant à une variété que je crois toujours valable, et qui est basée sur l'aspect différent des dactyles. Je reproduis ici les 2 figures de mon précédent travail, où l'on voit clairement, mieux que par toute déscription, la différence de forme et de proportion des deux griffes. Cette forme devra donc porter le nom de *S. metaneomeris* var. *streptodactylus*.

Quant à *S. metaneomeris*, l'espèce me paraît assez variable. Le sp. ♂ que j'ai figuré est un de ceux qui ont été communiqués à de Man et lui ont servi à la description de *S. streptodactylus*. Le scaphocérite s'étend jusqu'au milieu de l'article antennulaire distal, et toutes les épines sont très allongées. Cette différence n'est pas sexuelle autant qu'il en a paru, elle correspond à ce que j'ai appelé la forme "oxyceros" qui marque chez les Synalphées une véritable direction évolutive, si l'on en juge par sa fréquence. Les deux autres spécimens figurés sont des ♀, choisies parmi d'autres exemplaires pour la brièveté des épines antennaires et antennulaires, mais qu'il est impossible par ailleurs de séparer.

Cette espèce est la plus abondamment représentée du genre *Synalpheus* dans la collection. Elle a été recueillie dans les localités et stations suivantes:

Amirante Bank, st. 1, 2, 3, 5, 6, 9, 11, 13 (20—80 brasses); Saya de Malha, st. 10, 12 (47 et 90 brasses); Cargados Carajos, st. 8, 13, 15, 19, 20 (28—33 brasses); Providence, st. 11 (58 brasses).

8. *S. gravieri* H. Cout., Alph. Mald. et Lacc. p. 870, pl. 70, fig. 2.

Amirante Bank, st. 16, 18, 22 (16—280 brasses); Providence, st. 11 (58 brasses).

9. *S. merospiniger* H. Cout., Bull. Soc. Phil. 1908, p. 5. (Plate **60**, fig. 5.)

Amirante E. 25 (20—44 brasses). Une ♀ ovée.

10. *S. paraneomeris* H. Cout.

S. paraneomeris H. Cout., Alph. Mald. et Lacc. p. 872, pl. 71, fig. 7.

Chagos: Salomon, et Coin, Peros. Coetivy.

11. *S. paraneomeris, praslini* n. var. (Plate **61**, fig. 6.)

Quelques spécimens de Praslin récif se montrent nettement distincts par trois caractères: l'angle supéro-interne du basicérite est nettement prolongé en une épine, alors que l'absence d'épine en ce point est une des caractéristiques principales de l'espèce *paraneomeris*. Le méropodite de la 3e paire est plus large que dans les spécimens typiques, le rapport de ses dimensions étant seulement 3·5 au lieu de 4·5. Enfin les œufs sont notablement plus gros, mesurant 1·3 mm. de grand axe.

Seychelles, Praslin reef, 1 ♂, 1 ♀.

12. *S. paraneomeris, seychellensis* n. var. (Plate **61**, fig. 7.)

2 spécimens ♀ provenant des Seychelles diffèrent également du type par quelques caractères nets:

Le basicérite a son angle supéro-interne, sinon épineux, au moins aigu.

Les pattes de la 3e paire ont leur méropodite 4 fois aussi long que large, et le propodite porte 8 épines au lieu de 5 chez les spécimens typiques. C'est à ces exemplaires que j'ai comparés le *S. otiosus*. Par tout ses autres caractères, dimensions du carpocérite, forme du dactyle, telson, cette variété *seychellensis* ne s'éloigne pas de l'espèce *paraneomeris*.

Enfin il se trouve parmi des spécimens provenant de Coin, Peros Atoll, un ♂ de la forme "oxyceros," caractérisé par la longueur de toutes ses épines antennaires et antennulaires; le stylo et le basicérite atteignent sensiblement l'extrémité de l'article antennulaire médian, le scaphocérite, par son épine latérale, dépasse de beaucoup le carpocérite. C'est pour de tels exemplaires que j'ai proposé, sur l'invitation de Miss Rathbun, le nom de *paraneomeris prolatus*, mais je trouve la dénomination commune "oxyceros" infiniment plus expressive, parce qu'elle indique, comme je l'ai dit plus haut, une direction évolutive très répandue, pouvant servir à expliquer comment se sont constituées de nouvelles espèces.

13. *S. otiosus* H. Cout., Bull. Soc. Phil. 1908, p. 5. (Plate **61**, fig. 8.)

L'espèce se distingue du *S. paraneomeris* H. Cout. par les points suivants:

Le carpocérite est seulement 3 fois aussi long que large (au lieu de 4 fois).

Le méropodite de la grande pince est un peu plus épais dans sa moitié proximale, et se termine par une pointe obtuse.

Le méropodite de la 3e paire est seulement 3·5 fois aussi long que large, au lieu de 4·5 fois chez le *S. paraneomeris*, et le propodite qui porte 5 épines est également plus massif.

Le telson est plus large à son extrémité, le rapport de ses bases étant 1·5 au lieu de 1·85.

Coetivy, un bel exemplaire ♂.

14. *S. nilandensis* H. Cout., Alph. Mald. et Lacc. p. 871, pl. 70, fig. 4.

1 ex. Seychelles, st. 5 (44 brasses).

15. *S. nilandensis oxyceros* H. Cout., Alph. Mald. et Lacc. p. 871, pl. 70, fig. 5.

1 ex. Chagos, Egmont, lagoon.

16. *S. fossor* Paulson. Alph. Mald. et Lacc. p. 872, pl. 70, fig. 6.

1 ex. Chagos, Diego-Garcia, lagoon.

17. *S. trionyx* H. Cout., Bull. Soc. Phil. 1908, p. 6. (Plate **61**, fig. 9.)

L'espèce est très voisine du *S. fossor* Paulson, dont elle se distingue par les points suivants :

Les intervalles sont plus larges entre le rostre et les épines latérales, celles-ci étant, par suite, plus divergentes.

L'écaille du scaphocérite atteint au moins la moitié de l'article antennulaire distal, et l'épine latérale dépasse toujours le carpocérite, qui est 5 fois environ aussi long que large. Chez le *S. fossor*, l'écaille antennaire atteint rarement l'extrémité de l'article antennulaire médian, l'épine latérale est toujours plus courte que le carpocérite, et celui-ci est 6 fois plus long que large.

La grande pince est épineuse chez le *S. trionyx* à son bord palmaire antérieur, et le bord supéro-externe du méropodite se termine également par une forte épine. L'un et l'autre sont inermes chez le *S. fossor*, surtout la paume de la grande pince.

La petite pince du *S. trionyx* a pour proportions : doigts 1, longueur totale 2·4, hauteur 0·8. Le méropodite, dont le bord supéro-externe se termine en pointe aiguë, est 2·1 à 2·6 fois plus long que large. Il est toujours plus épais que la paume. Chez le *S. fossor* les proportions de la petite pince sont : doigts 1, longueur totale 2·85, hauteur 1·2, le membre étant plus trapu. Par contre, le méropodite grêle est 2·7 fois aussi long que large, et n'a que 0·6 de la hauteur de la paume.

Le premier segment du carpe est plus long que la somme des 4 autres chez le *S. trionyx*, plus court chez le *S. fossor*.

Les proportions de la 3e paire sont chez le *S. trionyx* : propodite 2·35, carpe 1, méropodite 2·6, celui-ci 4·4 fois aussi long que large. Chez le *S. fossor*, ces proportions sont : propodite 1·9 environ, carpe 1, méropodite 2·4, celui-ci 3·55 fois aussi long que large.

Enfin, le dactyle est de forme nettement différente. Chez le *S. fossor*, la griffe ventrale surnuméraire a ses deux côtés presque perpendiculaires, la griffe dorsale est très accessoire par rapport à la ventrale, et le groupe de ces 2 griffes est séparé du reste du dactyle par une faible dépression dorsale. Chez le *S. trionyx*, la surnuméraire ventrale est aiguë, dirigée en avant ; la dorsale est presque aussi longue que la griffe principale, et le dactyle ne montre aucune concavité dorsale.

Saya de Malha, C. 10 (26 brasses), 2 ex. ♂ et ♀ ; C. 19 (29 brasses), 1 ex. ♀.

18. *S. triunguiculatus* Paulson.

Cargados Carajos, st. 8, 13, 17 (30—32 brasses).

19. *S. charon* Heller.

Chagos : Salomon, Peros, Egmont, récif et lagon. Coetivy.

20. *S. biunguiculatus* Stimpson. H. Cout., Alph. des Mald. et Lacc. p. 873, pl. 71, fig. 8.

Amirante Bank, st. 6, 13, 21 (20—30 brasses). Chagos, Egmont.

21. *S. pachymeris* n. nom. (Plate **61**, fig. 10.)

S. biunguiculatus var. *pachymeris* H. Cout., Alph. Mald. et Lacc. p. 873, pl. 71, fig. 9.

Cette forme est nettement distincte du *S. biunguiculatus*. Elle est représentée dans la collection par quelques spécimens typiques, mais aussi par une forme dont je fais une variété *cargadosi* et qui s'en distingue par quelques caractères : l'angle supéro-interne du basicérite est à peine épineux, le méropodite de la 3e paire ne porte que 3 épines mobiles sur son bord inférieur, au lieu de 5, enfin le propodite n'a que 5 épines au lieu de 8, et il est plus court, mesurant 1·33 du carpe au lieu de 1·47 chez les spécimens typiques.

Cargados Carajos, 1 sp. ♀ (var. Cargadosi). Providence Island.

22. *S. lophodactylus* H. Cout., Bull. Soc. Phil. 1908, p. 7. (Plate **61**, fig. 11.)

Cette nouvelle espèce se distingue du *S. biunguiculatus* Stp. par les points suivants :

Le pédoncule antennulaire est plus court, l'article basal ne dépassant guère le rostre, et seulement 4 fois aussi long que large. Le stylocérite ne dépasse pas l'article basal.

L'écaille antennaire atteint l'extrémité de l'article antennulaire médian, et son épine latérale ne le dépasse que de la moitié environ de l'article antennulaire distal.

La basicérite est complètement inerme en dessus, détail qui différencie immédiatement les deux espèces. Le carpocérite dépasse notablement l'antennule, mais il est seulement 4 fois aussi long que large, ayant subi le même raccourcissement que les autres appendices céphaliques.

La grande pince est absente sur le type.

La petite pince a pour proportions : doigts 1, longueur totale 2·73, hauteur 0·88. Son méropodite est 3·3 fois aussi long que large. Le doigt mobile porte une brosse de soies sériées sur la moitié distale. Elles sont moins serrées et moins abondantes que dans le groupe *lævimanus*, mais n'en indiquent pas moins l'étroite parenté qui relie les deux groupes d'espèces. Chez le *S. biunguiculatus*, la petite pince est plus épaisse, et le doigt mobile n'a que des traces insignifiantes de la brosse de soies sériées.

Les pattes de la 3e paire ont pour proportions : propodite 1·9, carpe 1, méropodite 2·43. Ce dernier, très grêle, est 4·5 fois aussi long que large. Le dactyle est celui du *S. biunguiculatus*.

Lagon de Diego, 1 seul spécimen ♀.

23. *S. tumido-manus*, Paulson.

S. tumido-manus Paulson. H. Cout., Alph. Mald. et Lacc. p. 876, pl. 73, fig. 14.

Cargados Carajos, st. 2 (30 brasses), 1 ex. ♂.

24. *S. hastilicrassus* H. Cout., Alph. Mald. et Lacc. p. 875, pl. 72, fig. 12.

Amirante Bank, st. 21 (30 brasses) ; Providence, st. 11 (58 brasses).

25. *S. sladeni* H. Cout., Bull. Soc. Phil. 1908, p. 8. (Plate **62**, fig. 12.)

Cette espèce, l'une des plus remarquables recueillies par l'expédition, est jusqu'à présent la seule du groupe *lævimanus* qui soit présente dans la région indo-pacifique, à l'exception peut-être du *S. lævimanus haddoni* H. Coutière. Ce groupe est caractérisé, comme je l'ai montré, par la présence constante sur le doigt mobile de la petite pince d'une brosse de longues soies raides disposées en séries transversales, et occupant les $\frac{2}{3}$ de

l'article. Tout en présentant de façon très nette ce caractère, la nouvelle espèce se place bien à part dans le groupe *lævimanus*.

Le bord frontal présente en avant des yeux une avancée considérable, si bien que la pointe du stylocérite est au niveau de celle du rostre, et que l'épine latérale du basicérite n'atteint pas tout à fait les épines latérales du bord frontal.

Le scaphocérite est sensiblement aussi long que l'antennule, et son écaille atteint l'extrémité de l'article antennulaire médian, caractères insolites dans le groupe, ainsi que la faible épine inférieure du basicérite.

Le carpocérite est volumineux, 4·7 fois aussi long que large, plus long que les antennules.

Les fouets des maxillipèdes externes sont très asymétriques en longueur et surtout en volume. J'ignore si cette disposition est fortuite ou constante.

La grande pince a pour proportions: doigts 1, longueur totale 3·12, hauteur 0·84. Le doigt mobile dépasse un peu le doigt fixe. La paume est cylindrique, et sa grande longueur est également une caractère insolite.

Par contre, la petite pince ressemble beaucoup à celle du *S. longicarpus* Herrick, par sa forme, ses proportions, sa brosse de soies sériées.

La 2e paire est grêle, la 3e paire également. Les proportions de cette dernière sont: propodite 2, carpe 1, méropodite 2·15, ce dernier article 5·4 fois aussi long que large. La griffe est celle de toutes les espèces *lævimanus*.

Le telson a pour proportions: largeur distale 1, largeur proximale 2·7, hauteur 3 environ.

Pour l'avancée du bord frontal, la forme de la grande pince, la gracilité des pattes suivantes, la forme du telson, cette espèce rappelle les espèces du groupe *comatularum*, jusqu'à présent aussi exclusives à l'Indo-pacifique que le groupe *lævimanus* l'est aux côtes américaines.

Cargados Carajos, B. 2 (30 brasses), 1 seul ex. ♂.

Genre *Alpheus* Fabr.

26. *A. staphylinus* H. Cout., Bull. Soc. Phil. 1908, p. 14. (Plate **62**, fig. 13.)

L'espèce est très voisine de l'*A. megacheles* Hailstone de la Méditerranée et de l'Atlantique. Le rostre est 3 fois aussi long à peu près que les dents sus-orbitaires, il est plus court que l'article antennulaire basal. L'article médian est 1·5 fois aussi long que chacun des 2 autres. Le pédonculaire antennulaire, la forte épine latérale du scaphocérite, le carpocérite sont sensiblement égaux.

La grande pince est très semblable à celle de l'*A. megacheles* comme forme et proportions. La petite pince est plus grêle, la paume étant 2·43 fois aussi longue que large, au lieu de 2 fois, le doigt mobile n'est pas élargi, bien qu'il s'agisse d'un ♂, les doigts sont légèrement plus courts que la paume.

La 2e paire est très allongée, la somme du carpe et de la pince mesure 0·85 du cephalothorax, et la partie proximale du membre 1·05 de cette même longueur, ce qui distingue immédiatement l'espèce de l'*A. megacheles* et la rapproche de l'*A. hailstonei* des Maldives.

La 3e paire mesure 1·2 du céphalothorax, alors qu'elle l'égale seulement chez

l'*A. megacheles*. Le méropodite est 5 fois aussi long que large, et le propodite est 1·4 fois aussi long que la carpe, au lieu de 1·2 chez l'*A. megacheles*.

L'unique spécimen ♂, long de 12 mm., provient de Salomon Island (Chagos).

27. *A. hailstonei* H. Cout., Alph. Mald. et Lacc. p. 879, pl. 74, fig. 18.

Seychelles, st. 8, 9 (34 et 37 brasses). Maurice. Saya de Malha, st. 15 (55 brasses).

28. *A. paradentipes* H. Cout., Alph. Mald. et Lacc. p. 880, pl. 74, fig. 17.

Amirante Bank, st. 25, 26 (20—100 brasses). Providence, st. 11 (58 brasses).

29. *A. collumianus* Stimpson, Alph. Mald. et Lacc. p. 881.

Amirante Bank, st. 7, 10, 11, 13 (20—85 brasses). Providence, st. 1, 3 (29—39 brasses). Chagos, Salomon. Cargados Carajos, st. 20 (28 brasses).

30. *A. seurati* H. Cout., Alph. Mald. et Lacc. p. 881, pl. 75, fig. 20.

Amirante Bank, st. 13 (20—25 brasses). Coetivy.

31. *A. malhaensis* H. Cout., Bull. Soc. Phil. 1908, p. 15. (Plate **62**, fig. 14.)

L'espèce se rapproche particulièrement de l'*A. seurati* H. Cout. dont elle se distingue par les points suivants:

Antennes et antennules un peu plus grêles et allongées, y compris l'épine latérale du basicérite.

Bord inférieur de la grande pince entièrement lisse, constriction plus profonde entre la paume et le doigt fixe, extrémité du doigt mobile moins massive.

Carpe de la 2e paire avec les 2 premiers segments presque égaux, le premier légèrement plus long.

Méropodites de la 3e et 4e paires fortement épineux à l'apex inférieur distal, celui de la 3e paire 3·7 fois plus long que large. Proportions du membre : carpe 1, propodite 1·25, méropodite 1·9 (au lieu de 1, 1·45, 2 chez l'*A. seurati*, où le méropodite est seulement 3 fois aussi long que large, et le propodite également très épais).

Saya de Malha, C. 19 (29 brasses), 1 sp. ♀. Amirante, E. 2 (29 brasses), 1 sp. ♂.

32. *A. macrochirus* Richters. H. Cout., Alph. Mald. et Lacc. p. 882.

Chagos, Salomon Islands. Coetivy.

33. *A. ventrosus* H. M. Edwards, Alph. Mald. et Lacc. p. 882.

Seychelles, Praslin reef. Chagos: Diego Garcia, barachois; Salomon; Egmont, lagoon. Coetivy.

34. *A. gracilis* Heller.

Chagos, Salomon. Coetivy.

35. *A. gracilis* var. *alluaudi* H. Cout., Alph. Mald. et Lacc. p. 882.

Providence Island, 1 sp. mutilé.

36. *A. paragracilis* H. Cout., Alph. Mald. et Lacc. p. 883, pl. 76, fig. 22.

Coetivy.

Alpheus sp.? (Plate **62**, fig. 15.)

Metalpheus n. gen. ?

Il s'agit ici d'une forme très remarquable, peut-être identique à l'*A. rostratipes* Pocock,

ce que je ne saurais décider en l'absence du type. Cette identité ou valeur spécifique est d'ailleurs secondaires en l'espèce, en présence des différences qui séparent ces formes du genre *Alpheus* lui-même, et conduisent presque à la formation d'un nouveau genre.

Le rostre émerge entre les échancrures obliques des voûtes orbitaires, qu'il égale en longueur. La protection des ophthalmopodes n'est pas assurée du côté antéro-interne.

Comme chez l'*A. rostratipes*, les articles antennulaires sont aussi larges que longs. Toutefois, le 3e est 1·5 fois aussi long que large. Le stylocérite atteint le milieu de l'article médian. La large écaille du scaphocérite atteint le tiers proximal, et son épine la moitié de l'article distal antennulaire. Le basicérite est volumineux, beaucoup plus haut que long surtout, avec une forte épine latérale, et le carpocérite, dépassant l'antennule de la moitié au moins de l'article distal, n'est guère que 1·5 fois aussi long que large.

Le volume de l'antenne contrastant avec le faible développement du scaphocérite, l'épaisseur des articles et des fouets antennulaires sont des caractères insolites chez *Alpheus*, rappelant surtout les genres *Arete* et *Alpheopsis*.

Le labre possède également un volume excessif. Il descend verticalement entre les bases des antennes, et sa hauteur égale celle du céphalothorax, de façon à constituer une sorte de mufle qui donne à l'espèce une physionomie très spéciale. La partie inférieure en est enfermée, comme dans des valves, entre les psalistomes très élargis des mandibules, dont le palpe est entièrement invisible du dehors. Le psalistome porte une dizaine de faibles dents sur une courte portion de son bord supérieur. Le processus molaire est inclus, comme toujours, entre le labre et les paragnathes, très développés également. C'est là une forme de la mandibule unique jusqu'à présent chez les Alpheidæ.

La maxillule et la maxille ont leur forme normale. Sur le 1er maxillipède, l'article distal du sympodite est largement arrondi, l'endopodite et l'exopodite soudés sur leur tiers proximal, ce dernier avec un très étroit lobe *a* (Boas).

Le 2e maxillipède a son épipodite en forme de sac membraneux. Le 3e a son article distal foliacé, très élargi (un peu plus de 2 fois aussi long que large) excavé de façon à recevoir la masse du labre, des mandibules et des maxillipèdes précédents, comme chez l'*Alpheopsis fissipes* H. Cout. L'article distal est conique, pourvu des soies sériées habituelles, sans épines terminales. Il y a un bourgeon d'arthrobranchie à la base du membre, avec une trace de bifurcation.

Par une malchance singulière, les 2 spécimens que j'ai étudiés ne possèdent qu'une seule des pinces de la 1e paire, de même que les types de l'*A. rostratipes*. Je suis porté à croire que les deux pinces sont semblables. Sur un spécimen sec de l'*A. rostratipes* (S. Kensington Muséum) la seule pince présente est si volumineuse qu'elle représente bien plutôt la grande. Sur un des deux spécimens de la forme ici étudiée, la pince opposée est en voie de régénération, elle a dépassé le stade de forme indifférente, et apparaît très semblable à son opposée comme aspect général et proportions.

La 2e paire est courte et massive. Les segments du carpe décroissent du 1er au 4e, ce dernier plus large que long, le 5e égal au 1er. La 3e paire a le méropodite très massif, inerme, 3 fois aussi long que large. Le dactyle est bifide, avec une saillie ventrale surnuméraire plus marquée chez le ♂.

La 4e paire n'a pas d'épipodite en crochet. Les rames des pléopodes, chez le ♂, sont

beaucoup plus courtes que le sympodite, presque dépourvues de soies et de longueur égale. La 2e paire fait exception en ce que la rame interne est étroite et très longue.

Chez la ♀ les rames sont plus longues et aussi plus larges que le sympodite, et le rétinacle de la rame interne est lui-même très élargi, si bien que la rame paraît simplement bifurquée sur son tiers distal.

Volume des fouets antennaires et de l'antenne, incomplète protection des yeux, volume du labre, forme très spéciale des mandibules, du 2e maxillipède, du 3e maxillipède, des pinces de la 1e paire (?), brièveté de la 2e paire, réduction du nombre des épipodites, forme très spéciale des pléopodes, tels sont les caractères que l'on pourrait invoquer pour la séparation de l'*A. rostratipes* et des formes affines. Le nouveau genre pourrait recevoir le nom de *Metalpheus* s'il était conservé.

D'autre part, ces espèces montrent avec l'*A. paragracilis* H. Cout. une ressemblance très grande, au point que tous leurs caractères différentiels s'y retrouvent, *y compris l'absence d'épipodite sur la* 4e *paire*. Mais ces caractères sont pour la plupart atténués. Il en est ainsi pour le volume de l'antenne et sa disproportion d'avec le scaphocérite, pour le volume du labre, la grandeur du psalistome des mandibules, du sympodite du 1er maxillipède, la largeur de l'article basal du 3e maxillipède, le volume de la petite pince, la brièveté de la 2e paire, pour la forme même des pléopodes. En un mot, l'*A. paragracilis* ne possède plus en propre qu'un seul caractère le séparant nettement du genre *Alpheus*, l'épipodite du 4e péréiopode. Et si l'on passe à des espèces telles que l'*A. socialis*, également très voisine, ce dernier détail disparaît.

On voit donc l'intérêt qui s'attache à la connaissance plus complète de l'*A. rostratipes* (et de l'*A. sp* ? qui en est peut-être distinct) surtout pour savoir si la grande pince est ou non celle d'un *Alpheus*.

On peut noter que l'*Alpheopsis fissipes*, la nouvelle espèce décrite plus avant, possède, seule du genre, les maxillipèdes de la 3e paire très élargis et les dactyles bifides. Si, là encore, les pinces de la 1re paire étaient connues, peut-être possèderait-on un repère précieux pour fixer la validité du genre *Metalpheus*. Par son rostre, l'*Alpheopsis fissipes* se rattache à l'*A. equalis*, dont les pinces ne sont pas sillonnées. On conçoit très bien dès lors qu'une forme telle que *Metalpheus*, dans l'hypothèse où ses pinces seraient semblables et non sillonnées, soit sortie d'une autre telle que l'*Alpheopsis fissipes*.

D'autre part, le groupe *megacheles*, parmi les Alphées, présente comme je l'ai montré, les ressemblances les plus étroites avec les *Alpheopsis* tel que l'*A. trispinosus* et l'*A. chilensis*, à pinces sillonnées. Comme les 2 sections du genre *Alpheopsis* sont fort voisines, il n'est pas étonnant de rencontrer chez leurs dérivés *Alpheus* et *Metalpheus* des convergences comme celles qui rapprochent l'*A. rostratipes* et l'*A. paragracilis*.

37. *Alpheus amirantei* H. Cout., Bull. Soc. Phil. 1908, p. 15. (Plate **63**, fig. 16.)

Cette espèce se rapproche plus de l'*A. paragracilis* H. Cout. que d'aucune autre, mais elle en est facilement séparable.

Le rostre étroit se continue par une faible crête, un peu élargie derrière les voûtes orbitaires ; il est séparé de celles-ci, en avant, par deux très faibles sinus concaves du bord frontal, le reste du bord étant régulièrement convexe et inerme.

Le stylocérite est plus court que l'article antennulaire basal, ou à peine aussi long, le basicérite de l'antenne est à peu près inerme.

Le bord inférieur de la grande pince est droit, sans trace de constriction. Le bord supérieur porte au contraire une constriction transverse et un sillon longitudinal du côté inféro-interne. Du côte supéro-externe est un second sillon longitudinal très faible. Le méropodite porte une forte épine à son bord inférieur interne.

La petite pince diffère de celle de l'*A. paragracilis* par sa taille relative moindre, les doigts égaux à la paume, le méropodite pourvu d'une forte épine.

Sur la 2e paire, le 1er segment du carpe n'a guère que le tiers du second.

La 3e paire et la 4e ont le méropodite fortement épineux à son bord inférieur distal, le propodite est seulement un peu plus long que le carpe, l'un et l'autre sont beaucoup plus faibles que le méropodite. Le dactyle est simple. C'est une forme du membre surtout fréquente dans le groupe *crinitus*.

Amirante E. 11 (25—80 brasses), 2 spécimens ♂.

38. *Alpheus baculifer* H. Cout., Bull. Soc. Phil. 1908, p. 16. (Plate **63**, fig. 17.)

Je place ici cette très remarquable espèce. Elle représente un cas extrême d'allongement des pinces chez une forme qui, par la plupart de ses caractères, rentre dans le groupe *obeso-manus*. C'est le parallèle de l'*A. cylindricus* Kingsley pour le groupe *megacheles*.

Le rostre, très court, dépasse à peine les voûtes orbitaires très saillantes, et se continue en arrière par une crête assez marquée. L'article antennulaire médian est 1·5 fois aussi long que chacun des deux autres, le stylocérite est plus court que l'article médian et ne fait qu'une faible saillie latérale. Le scaphocérite ne possède qu'une écaille rudimentaire, et son épine latérale ne dépasse pas le tiers distal de l'article antennulaire médian. Le carpocérite est à peine plus long que ce même article.

Les pattes de la 1e paire sont extrêmement caractéristiques. La grande pince a la paume cylindrique, 5·5 fois aussi longue que large. Elle est tronquée à l'extrémité ; le doigt mobile, en "porte à faux," sur plus de la moitié de sa longueur, est dirigé presque perpendiculairement à la paume. Il n'y a plus trace de sillons palmaires. Le méropodite est également très allongé.

La paume de la petite pince est de même forme, mais les doigts sont parallèles, égaux, et dans le prolongement du membre. Ses proportions sont : doigts 1, longueur totale 4·34, hauteur 0·55.

Les pattes de la 2e paire sont très inégales, comme dans la plupart des espèces *obeso-manus*. La plus longue mesure 1·66 fois celle de la 3e paire, la plus petite 1·33 fois. Le second segment du carpe est très légèrement plus long que le premier, la pince distale a les doigts très courts.

La 3e paire a pour proportions : carpe 1, propodite 1·07, méropodite 1·46. Ce dernier est inerme, et 3·6 fois aussi long que large.

L'unique spécimen est une ♀ venant de muer dont les pleurons abdominaux sont très grands, comme il est de règle dans ce groupe d'espèces. Le telson et les uropodes sont dans le même cas ; la rame interne de ces derniers a son bord externe triangulaire, la suture de la rame externe porte 2 courtes épines.

Ile du Coin, Peros (Chagos), une ♀ de 25 mm.

39. *A. ovaliceps* H. Cout., Alph. Mald. et Lacc. p. 888, pl. 77, fig. 27.

Chagos : Coin, Peros.

40. *A. stanleyi* H. Cout., Bull. Soc. Phil. 1908, p. 17. (Plate **63**, fig. 18.)

Cette espèce se rapproche beaucoup de l'*A. ascensionis* Ortmann, de l'*A. architectus* de Man, de l'*A. styliceps* H. Coutière.

La forme du bord frontal est très semblable à celle de l'*A. styliceps*, les voûtes orbitaires étant toutefois reportées plus en arrière encore. L'écaille du scaphocérite atteint le tiers distal de l'article antennulaire médian, tandis qu'en revanche l'épine latérale atteint à peine le milieu de l'article distal. Le carpocérite ne dépasse que très faiblement l'antennule.

La grande pince est celle de l'*A. ovaliceps* H. Coutière, et se distingue par suite de celle des 3 espèces précitées. Le doigt mobile est toutefois beaucoup plus en "porte à faux." Les sillons palmaires sont à peu près nuls. Ses proportions sont : doigt mobile 1, longueur totale 3·4, hauteur 1·4.

La petite pince a pour proportions : doigts 1, longueur totale 2, hauteur 1·72. Elle est, par suite, de forme banale, et bien distincte de celle de l'*A. styliceps*. Les doigts sont béants, l'inférieur très large ; leur bord inféro-externe excavé porte une rangée de fortes soies courtes et espacées, au nombre d'une dizaine.

Sur la 2e paire, le 2e segment du carpe est un peu plus court que le premier.

La 3e paire a pour proportions : propodite 1·4, carpe 1, méropodite 2·25. Ce dernier, presque 5 fois aussi long que large, porte une forte épine à son angle inférieur distal. Il en est de même sur la 4e paire. Le dactyle est très court, sans trace de bifurcation.

Le telson a pour proportions : petite base 1, grande base 2, hauteur 3·27. Le bord de l'uropode interne porte une série de courtes épines.

Chez l'*A. architectus* et l'*A. ascensionis*, indépendamment des autres différences, les méropodites 3 et 4 sont inermes.

Amirante E. 21 (30 brasses), un unique sp. ♂ de 18 mm.

41. *A. microstylus* H. Cout., Alph. Mald. et Lacc. p. 884, pl. 76, fig. 23. Coetivy.

42. *A. phrygianus* H. Cout., Alph. Mald. et Lacc. p. 886, pl. 77, fig. 25.

Chagos : Salomon Island, lagoon. Providence, st. 1 (39 brasses). Amirante, st. 21 (30 brasses).

43. *A. lutini* H. Cout., Alph. Mald. et Lacc. p. 885, pl. 76, fig. 24. Coetivy.

44. *A. bradypus* H. Cout., Alph. Mald. et Lacc. p. 891, pls. 78—79, fig. 30. Coetivy.

45. *A. bucephalus* H. Cout., Alph. Mald. et Lacc. p. 890, pl. 78, fig. 29.

Providence, st. 4, 7 (50 et 70 brasses). Chagos : Salomon ; Diego Garcia, barachois. Amirante Bank, st. 9, 13, 16, 29 (20—44 brasses). Coetivy.

46. *A. aculeipes* H. Cout., Alph. Mald. et Lacc. p. 892, pl. 79, fig. 31.

Amirante Bank, st. 2, 9, 11, 13, 16, 21 (20—39 brasses). Seychelles, st. 1, 5, 8, 9 (20—44 brasses). Saya de Malha, st. 10, 19 (90 et 55 brasses). Coetivy, récif. Chagos : Diego Garcia.

47. *A. paraculeipes* H. Cout., Alph. Mald. et Lacc. p. 894, pls. 79—80, fig. 32.

Amirante Bank, st. 13, 21 (20—30 brasses).

48. *A. providencei* H. Cout., Bull. Soc. Phil. 1908, p. 18. (Plate **63**, fig. 19.)

Le difficile groupe *crinitus*, déjà si riche en espèces, a fourni encore ici plusieurs formes nouvelles, séparées des formes connues par de minimes différences.

Par la forme du bord frontal et des appendices céphaliques, l'*A. providencei* rappelle absolument l'*A. aculeipes* H. Coutière. Ici, toutefois, le rostre fait à peine saillie en avant; sa crête médiane est au contraire plus forte, et s'élargit plus rapidement derrière les voûtes orbitaires.

Par ses autres caractères, l'espèce se rapproche davantage de l'*A. paraculeipes* H. Coutière, sans être toutefois intermédiaire entre les deux formes précitées.

La grande pince, dont les proportions sont : doigts 1, longueur totale 3·33, hauteur 1·5, a une forme régulièrement ovoïde ; ses doigts sont fortement infléchis en dedans. Le méropodite épineux est 2·2 fois plus long que large.

La petite pince (♀) est très semblable à celle de l'*A. paraculeipes*. Les doigts sont seulement plus longs, ses proportions étant : doigts 1, longueur totale 2·18, hauteur 0·8.

Les deux premiers segments du carpe sont entre eux comme 1 et 1·95, rapport moindre que dans les deux espèces précitées.

Pour la 3e paire, les proportions sont : propodite 1·5, carpe 1, méropodite 2·3. Ce dernier 4 fois plus long que large. L'épine mérale est dans le prolongement du bord inférieur, étroite et très aiguë. Le bord inférieur interne est absolument nu, d'où une différence notable d'avec les *A. aculeipes* et *paraculeipes*.

Le bord externe du carpe porte une épine et 8—10 soies, mais celles-ci sont effilées, molles, et bien différentes de celles de l'*A. paraculeipes*. Le propodite n'a pas d'épine distale au bord supérieur. Le dactyle porte au bord ventral une saillie surnuméraire très nette. L'ischiopodite n'a pas d'épine enfoncée. Le méropodite de la 4e paire n'est pas épineux.

L'espèce est encore plus voisine de l'*A. alcyone* de Man. Dans cette dernière forme, le scaphocérite a son bord externe concave, son épine latérale plus longue ; le méropodite de la petite pince est inerme ; le premier segment du carpe mesure seulement le tiers du second, et il est surtout plus petit que le 5e. Le méropodite de la 3e paire porte quelques spinules courbées en S, le dactyle n'est pas bifide; le carpe de la 4e paire est semblable à celui de la 3e. Enfin, les œufs sont rares et volumineux, donnant vraisemblablement naissance à des larves mysis.

On peut considérer l'*A. alcyone* et l'*A. providencei* comme deux formes pœcilogoniques, mais, ici comme dans la grande majorité des cas connus, il s'ajoute au caractère tiré du volume des œufs une série de menues différences montrant que les deux formes sont bien spécifiquement distinctes.

Providence D. 4 (50—78 brasses), 1 sp. ♀.

49. *A. alcyone* de Man ? H. Cout., Alph. Mald. et Lacc. p. 896.

Amirante Bank, st. 13 (20—25 brasses).

50. *A. paralcyone* H. Cout., Alph. Mald. et Lacc. p. 895, pls. 80—81, fig. 34.

Amirante Bank, st. 11, 13, 21 (20—80 brasses). Seychelles, st. 8 (34 brasses).

51. *A. superciliaris* H. Cout., Alph. Mald. et Lacc. p. 896, pl. 81, fig. 35.

Amirante Bank, st. 21, 25 (209—160 et 44—20 brasses).

52. *A. pachychirus* Stimpson.

Chagos : Salomon ; Egmont. Coetivy.

Cowles a minutieusement décrit, récemment, la façon dont cette espèce se construisait un tube à l'aide d'Algues vertes pour s'y loger par couples. Il s'agit plus probablement de l'*A. frontalis* = *Betæus utricola* Richters.

53. *A. frontalis* H. M. Edwards.

Amirante Bank, st. 9, 11, 13 (20—80 brasses). Chagos : Egmont ; Salomon. Seychelles : st. 2 (31 brasses) ; Praslin, récif. Coetivy.

54. *A. clypeatus* H. Cout., Alph. Mald. et Lacc. p. 897, pls. 81—82, fig. 36.

Chagos : Egmont, récif.

55. *A. adamastor* H. Cout., Bull. Soc. Phil. 1908, p. 19. (Plate **64**, fig. 20.)

Cette espèce est extrêmement voisine de l'*A. clypeatus* H. Coutière. Elle en diffère par les points suivants :

Le bord frontal présente une avancée convexe en deçà de chaque voûte orbitaire, mais, au lieu de se réunir en un rostre saillant, les voûtes sont séparées par un sinus médian, aussi large que chacune d'elles. La crête mousse du rostre, qui paraît s'arrêter au bord de ce sinus, se continue en réalité un peu en avant et sur un plan inférieur, en une pointe étroite et très courte.

Le basicérite porte une épine beaucoup plus faible que chez l'*A. clypeatus*.

La grande pince a pour proportions : doigts 1, longueur totale 3, hauteur 1·34. Elle est donc légèrement plus massive que chez l'*A. clypeatus*, où les doigts ont aussi 1/3 de la longueur totale, mais où le second rapport est 1·23 seulement.

La petite pince présente des différences bien plus notables. Elle a pour proportions : doigts 1, longueur totale 2·36, hauteur 0·75. Elle est donc 3 fois plus longue que haute, au lieu de 2·6 chez l'*A. clypeatus* ♂. Elle rappelle par suite les proportions de l'appendice chez la ♀ de l'espèce précitée, mais le doigt mobile est ici notablement élargi. Il est vraisemblable que la différence sexuelle dans la forme de la petite pince, chez l'*A. adamastor* dont la ♀ est inconnue, porte sur ce détail du doigt mobile, et qu'elle est par suite assez faible.

Le méropodite inerme est à peine plus court que la pince et presque 3 fois aussi long que large. Ce dernier rapport égale 2 chez l'*A. clypeatus* ♂, le méropodite étant beaucoup plus court que la pince.

Sur la 2e paire, le 1er segment du carpe égale 1·6 fois le second. Ils sont sensiblement égaux chez l'*A. clypeatus*.

La 3e paire est très semblable comme proportions et forme à celle de l'*A. clypeatus*, mais le méropodite est 4 fois aussi long que large, au lieu de 3·5 fois.

La forme du bord frontal et les proportions de la petite pince du ♂ permettent aussi de distinguer aisément cette espèce de l'*A. pachychirus* Stimpson.

Salomon (Chagos), un unique spécimen ♂.

56. *A. longecarinatus* Hilgendorf.

Amirante Bank, E. 13 (20—25 brasses). Providence, D. 1 (39 brasses).

57. *A. insignis* Heller.

Chagos : Egmont ; Salomon. Coetivy.

58. *A. lanceloti* H. Cout., Alph. Mald. et Lacc. p. 901, pl. 83, fig. 39.

Amirante Bank, E. 11 (25—80 brasses).

59. *A. splendidus* H. Cout., Bull. Mus. Paris, 1897, no. 6, p. 235.

Seychelles : Praslin, récif.

60. *A. dasycheles* H. Cout., Bull. Soc. Phil. 1908, p. 21. (Plate **64**, fig. 21.)

L'espèce se rapproche de l'*A. gracilipes* Stimpson par la forme du rostre. C'est une large pointe triangulaire à bords légèrement concaves, 1·5 fois aussi longue que large à la base. Il y a sur la ligne médiane une trace de l'épine gastrique. Les bords du rostre surplombent les sillons rostro-orbitaires comme chez l'*A. gracilipes*, et les voûtes orbitaires présentent en avant une saillie obtuse, ne dépassant pas le bord frontal sinueux. La pointe du rostre n'atteint pas l'extrémité de l'article antennulaire basal, que le stylocérite dépasse légèrement.

L'écaille du scaphocérite égale le pédoncule antennulaire, que son épine latérale dépasse des 3/4 environ de l'article distal. L'épine latérale du basicérite atteint en avant aussi loin que le rostre, le carpocérite ne dépasse pas l'extrémité de l'article antennulaire médian.

Les pinces de la 1e paire sont cylindriques et entières, sans traces de sillons et de lobes. Elles possèdent un revêtement assez dense de longues soies sur leur face inféro-externe. La plus grande a pour proportions : doigts 1, longueur totale 3·2, hauteur 0·9.

La plus petite : doigts 1, longueur totale 2·38, hauteur 0·5. Sur la 2e paire, le 1er segment égale 1·2 fois le second. La 3e paire a pour proportions : propodite 1·64, carpe 1, méropodite 1·88. Ce dernier est 5 fois aussi long que large, l'ensemble du membre étant grêle, mais le méropodite porte une forte épine à son apex inférieur. Le carpe se termine également par une épine. Le dactyle est simple. Il y a une épine enfoncée mobile sur l'ischiopodite.

Seychelles, F. 9 (37 brasses), 2 sp. ♂ et ♀, le plus grand mesurant 22 mm.

61. *A. percyi* H. Cout., Bull. Soc. Phil. 1908, p. 21. (Plate **64**, fig. 22.)

Cette espèce se rapproche également de l'*A. gracilipes*, plus même que la précédente.

Le rostre a la même forme lancéolée, à bords surplomblant les sillons rostro-orbitaires. Mais les voûtes orbitaires sont régulièrement hémisphériques, sans lobe antérieur saillant, de sorte qu'entre elles, le rostre et le bord frontal, il n'existe pas la partie plane du sillon rostro-orbitaire brusquement élargi en avant que l'on remarque chez l'*A. gracilipes*.

Le rostre atteint, du même que le stylocérite, la longueur de l'article antennulaire basal.

L'écaille antennaire atteint au moins l'extrémité du pédoncule antennulaire, qu'elle dépasse même notablement chez les grands spécimens. Son épine latérale et le carpocérite comme dans l'espèce précédente, et comme chez l'*A. gracilipes*.

Les pattes de la 1e paire ne diffèrent que très peu de celles de l'*A. gracilipes*. La grande pince est entaillée d'un profond sillon transverse un peu avant l'articulation du doigt mobile ; la petite pince, "*balæniceps*" chez les ♂, est munie d'une forte épine sur

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chacun des condyles articulaires du doigt mobile. Les bords supéro-externe et inféro-externe du méropodite se terminent chacun par une forte épine, sur les 2 pinces.

Sur la 2e paire, les 2 premiers segments du carpe, presque égaux, sont entre eux comme 1, 1·15. J'ai étudié des spécimens jeunes où le rapport était sensiblement inverse.

La 3e paire est très semblable à celle de l'espèce précédente comme forme et proportions.

Cargados Carajos (30 brasses), 2 sp. ♂ et ♀, le plus grand mesurant 40 mm. Amirante E. 11 (25—50 brasses), 1 petit sp. ♀. Coetivy, 1 petit sp. ♂.

62. *A. coetivensis* H. Cout., Bull. Soc. Phil. 1908, p. 20. (Plate **64**, fig. 23.)

L'espèce se rapproche beaucoup de l'*A. paracrinitus* Miers et de la forme que j'ai décrite comme var. *bengalensis* de cette dernière.

Les voûtes orbitaires sont ici atténuées en forme d'épines plates mesurant à peu près la moitié de l'article antennulaire médian. Le scaphocérite a son écaille plus large, son épine latérale moins grande que dans les deux formes précitées, et le carpocérite est plus volumineux.

La grande et la petite pince sont tout à fait celles de l'*A. paracrinitus bengalensis* comme forme et proportions, la petite pince étant inerme sur le condyle articulaire externe du doigt mobile. Les méropodites sont inermes.

Sur la 2e paire, le premier segment du carpe est 1·7 fois aussi long que le 2e, sensiblement comme chez l'*A. paracrinitus*.

Sur la 3e paire, très grêle, les proportions sont : propodite 1·45, carpe 1, méropodite 1·7, le membre étant encore plus allongé que chez l'*A. paracrinitus*.

Coetivy, 1 sp. ♂. Chagos : Salomon, 1 sp. ♀ avec sa petite pince seule présente.

63. *A. alpheopsides* H. Cout., Alph. Mald. et Lacc. p. 901, pl. 83, fig. 40. Chagos: Salomon.

64. *A. paralpheopsides* H. Cout. Chagos : Salomon.

65. *A. parvirostris* Dana. Chagos: Egmont; Salomon. Seychelles : Praslin. Coetivy.

66. *A. hippothoë* de Man. Amirante Bank, E. 13 (20—25 brasses).

67. *A. bouvieri* H. M. Edwards, Alph. Mald. et Lacc. p. 907, pl. 85, fig. 44. Chagos : Salomon ; Coin, Peros. Cargados Carajos. Coetivy.

68. *A. bastardi* H. Cout., Alph. Mald. et Lacc. p. 907, pl. 87, fig. 45. Chagos: Salomon; Coin, Peros. Coetivy.

69. *A. pacificus* Dana, Alph. Mald. et Lacc. p. 909, pls. 85—86, fig. 47. Chagos : Salomon ; Coin, Peros.

70. *A. audouini* H. Cout., Alph. Mald. et Lacc. p. 911, pl. 87, fig. 52. Chagos : Salomon.

71. *A. strenuus* Dana, Alph. Mald. et Lacc. p. 913, pl. 87, fig. 53. Chagos : Salomon.

72. *A. strenuus angulatus* H. Cout., Alph. Mald. et Lacc. p. 914. Chagos : Salomon. Amirante Bank, E. 11 (25—80 brasses).

73. *A. leptochirus* H. Cout., Alph. Mald. et Lacc. p. 914, pl. 87, fig. 54. Chagos : Egmont ; Salomon. Amirante Bank, E. 11 (25—80 brasses). Cargados Carajos.

EXPLICATION DES PLANCHES 60—64.

Fig. 1. *Automate salomoni* H. Cout., région céphalique vue en dessus; 1′, région céphalique vue latéralement; 1 *a*, patte; 1 *b*, telson et uropodes.

Fig. 2. *Alpheopsis idiocarpus* H. Cout., région céphalique vue en dessus; 2 *a*, patte de la deuxième paire; 2 *b*, patte; 2 *c*, telson et uropodes.

Fig. 3. *Alpheopsis fissipes* H. Cout., région céphalique vue en dessus; 3 *a*, maxillipède III; 3 *b*, 2e péréiopode; 3 *c*, patte; 3 *c*′, dactylopodite; 3 *d*, œuf.

Fig. 4. *Synalpheus metaneomeris* n. nom., région céphalique vue en dessus (♂); 4′, 4″, la même (♀); 4 *a*, détail de l'antenne; 4 *b*, 3e patte; 4 *c*, 4e patte; 4 *c*′, dactylopodite; 4 *c*″, dactylopodite; 4 *c*‴, var. *streptodactylus* dactylopodite; 4 *d*, telson; 4 *e*, œuf.

Fig. 5. *Synalpheus merospiniger* H. Cout., région céphalique vue en dessus; 5 *a*, détails de l'antenne; 5 *b*, patte; 5 *c*, dactylopodite; 5 *d*, telson; 5 *e*, œuf.

Fig. 6. *Synalpheus paraneomeris praslini* n. var., région céphalique vue en dessus; 6 *a*, patte; 6 *b*, œuf.

Fig. 7. *Synalpheus paraneomeris seychellensis* n. var., région céphalique vue en dessus; 7 *a*, dactylopodite.

Fig. 8. *Synalpheus otiosus* H. Cout., région céphalique vue en dessus; 8 *a*, détails de l'antenne; 8 *b*, grande pince; 8 *b*′, la même, méropodite et carpe; 8 *c*, petite pince; 8 *c*′, la même, méropodite et carpe; 8 *d*, patte; 8 *d*′, dactylopodite; 8 *f*, telson.

Fig. 9. *Synalpheus trionyx* H. Cout., région céphalique vue en dessus; 9 *a*, détails de l'antenne; 9 *b*, grande pince; 9 *b*′, — méropodite et carpe; 9 *c*, petite pince; 9 *d*, 2e péréiopode; 9 *f*, patte; 9 *f*′, dactylopodite.

Fig. 10. *Synalpheus pachymeris cargadosi* n. var., région céphalique vue en dessus; 10 *a*, patte.

Fig. 11. *Synalpheus lophodactylus* H. Cout., région céphalique vue en dessus; 11 *a*, détails de l'antenne; 11 *b*, petite pince; 11 *c*, 2e péréiopode; 11 *d*, patte; 11 *d*′, dactylopodite; 11 *f*, telson.

Fig. 12. *Synalpheus sladeni* H. Cout., région céphalique vue en dessus; 12 *a*, grande pince; 12 *b*, petite pince; 12 *c*, 2e péréiopode; 12 *d*, patte; 12 *d*′, dactylopodite; 12 *f*, telson.

Fig. 13. *Alpheus staphylinus* H. Cout., région céphalique vue en dessus; 13′, région céphalique vue latéralement; 13 *a*, grande pince; 13 *a*′, petite pince; 13 *a*″, la même, méropodite; 13 *b*, 2e péréiopode; 13 *c*, patte.

Fig. 14. *Alpheus malhaensis* H. Cout., région céphalique vue en dessus; 14 *a*, grande pince; 14 *a*′, la même, méropodite et carpe; 14 *b*, 2e péréiopode; 14 *c*, patte.

Fig. 15. *Alpheus* sp., région céphalique vue en dessus; 15′, région céphalique vue latéralement; 15 *a*, mandibule; 15 *b*, maxillipède I; 15 *c*, maxillipède III; 15 *d*, grande pince; 15 *f*, 2e péréiopode; 15 *g*, patte; 15 *g*′, dactylopodite; 15 *h*, pléopodes de la femelle; 15 *h*′, pléopodes du male.

Fig. 16. *Alpheus amirantei* H. Cout., région céphalique vue en dessus; 16 *a*, grande pince; 16 *a*′, la même, méropodite et carpe; 16 *b*, petite pince; 16 *c*, 2e péréiopode; 16 *d*, patte.

Fig. 17. *Alpheus baculifer* H. Cout., région céphalique vue en dessus; 17 *a*, grande pince; 17 *b*, petite pince; 17 *c*, 2e péréiopode; 17 *d*, patte; 17 *f*, telson et uropodes.

Fig. 18. *Alpheus stanleyi* H. Cout., région céphalique vue en dessus; 18′, région céphalique vue latéralement; 18 *a*, détail de maxillipède III; 18 *b*, grande pince; 18 *b*′, la même, méropodite et carpe; 18 *c*, petite pince; 18 *c*′, détails de la petite pince; 18 *d*, 2e péréiopode; 18 *f*, telson et uropodes.

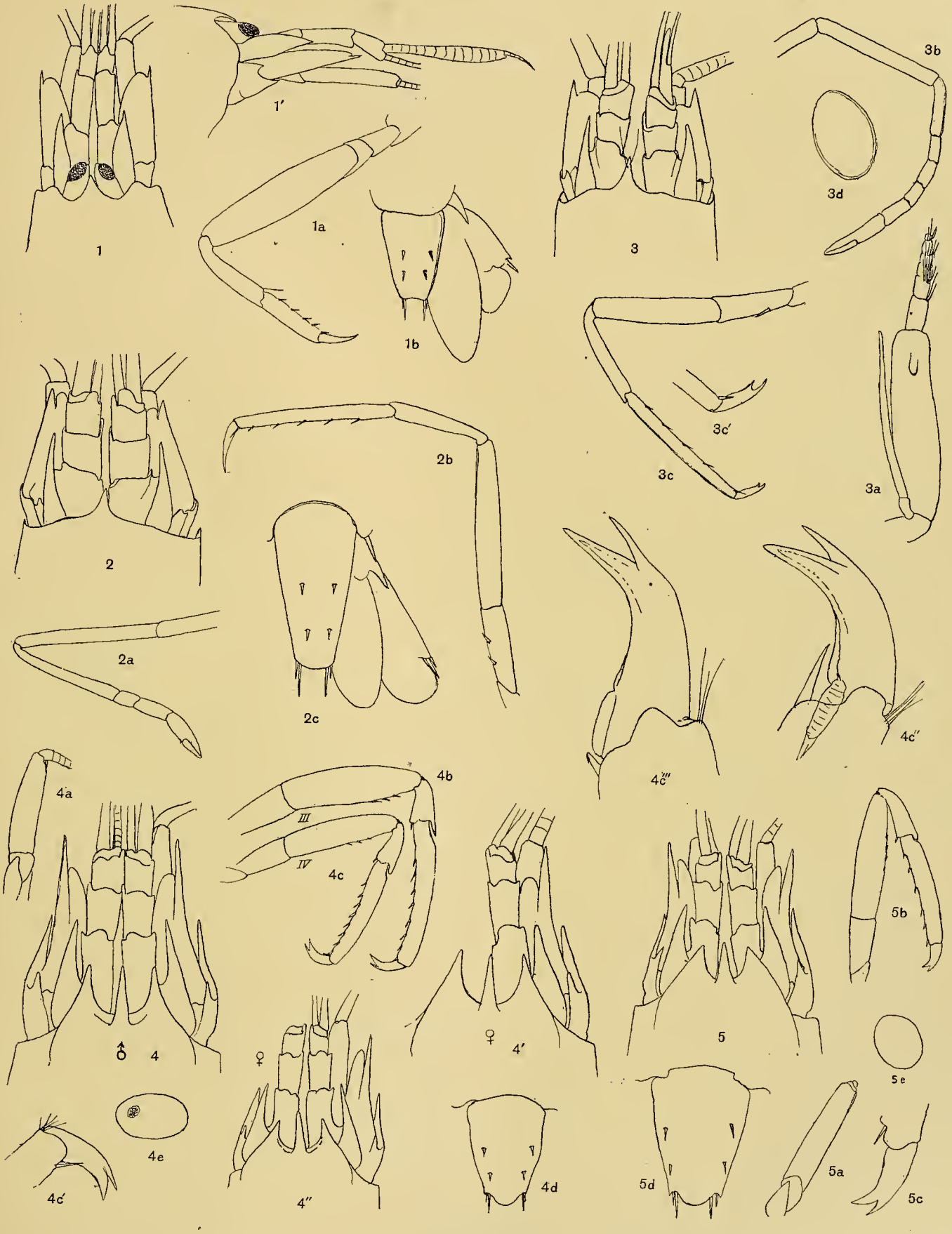
Fig. 19. *Alpheus providencei* H. Cout., région céphalique vue en dessus; 19 *a*, grande pince; 19 *a*′, la même, méropodite et carpe; 19 *b*, petite pince; 19 *c*, 2e péréiopode; 19 *d*, patte; 19 *d*′, dactylopodite; 19 *f*, détails; 19 *g*, telson.

Fig. 20. *Alpheus adamastor* H. Cout., région céphalique vue en dessus; 20 *a*, détail de maxillipède III; 20 *b*, grande pince; 20 *c*, petite pince; 20 *d*, 2e péréiopode; 20 *f*, patte.

Fig. 21. *Alpheus dasycheles* H. Cout., région céphalique vue en dessus; 21 *a*, grande pince; 21 *b*, petite pince; 21 *c*, 2e péréiopode; 21 *d*, patte; 21 *f*, telson et uropodes.

Fig. 22. *Alpheus percyi* H. Cout., région céphalique vue en dessus; 22′, région céphalique vue latéralement; 22 *a*, grande pince: 22 *b*, petite pince; 22 *c*, 2e péréiopode; 22 *d*, patte; 22 *f*, telson et uropodes.

Fig. 23. *Alpheus coetivensis* H. Cout., région céphalique vue en dessus; 23 *a*, grande pince; 23 *b*, petite pince; 23 *b*′, la même, méropodite et carpe; 23 *c*, 2e péréiopode; 23 *d*, patte.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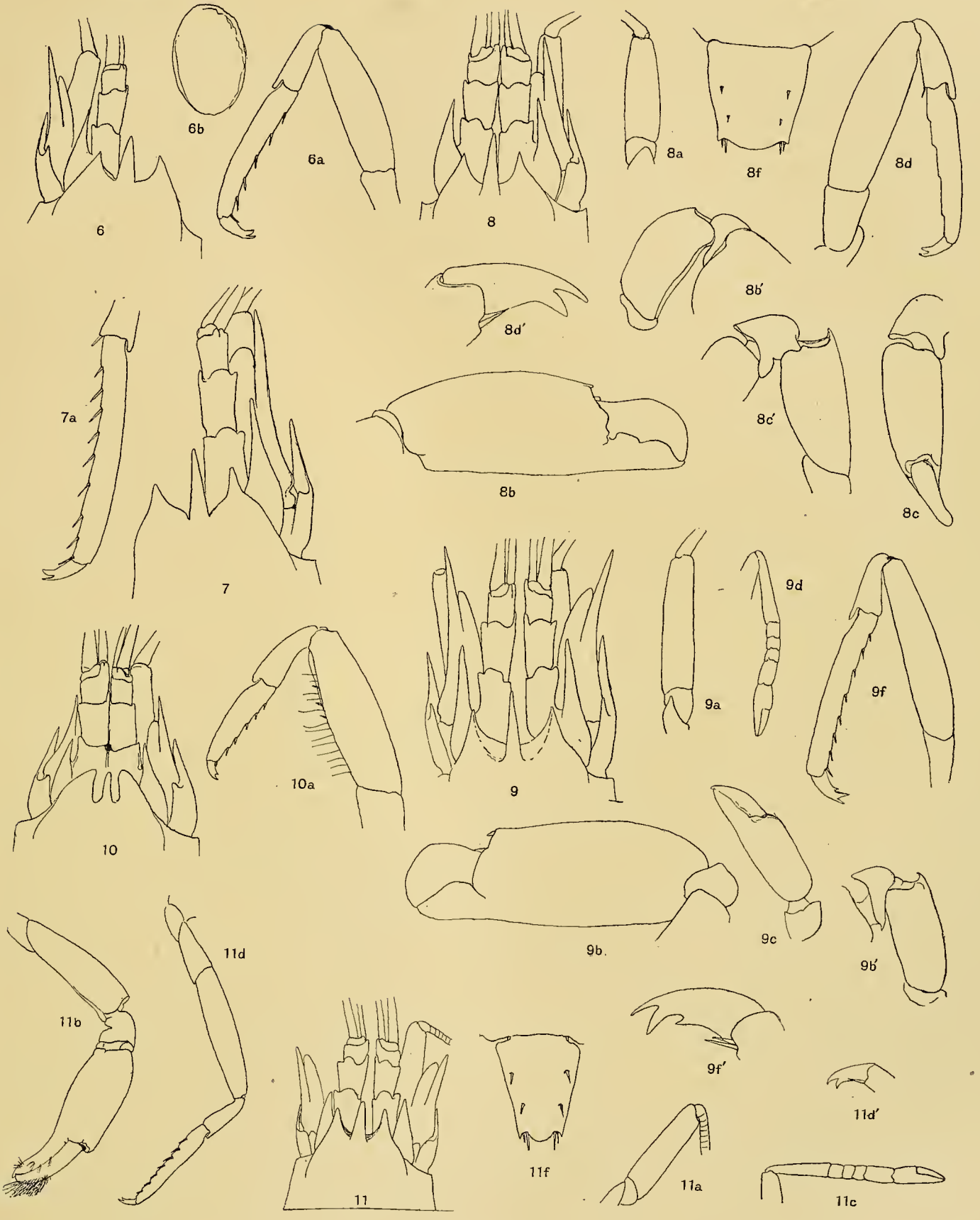
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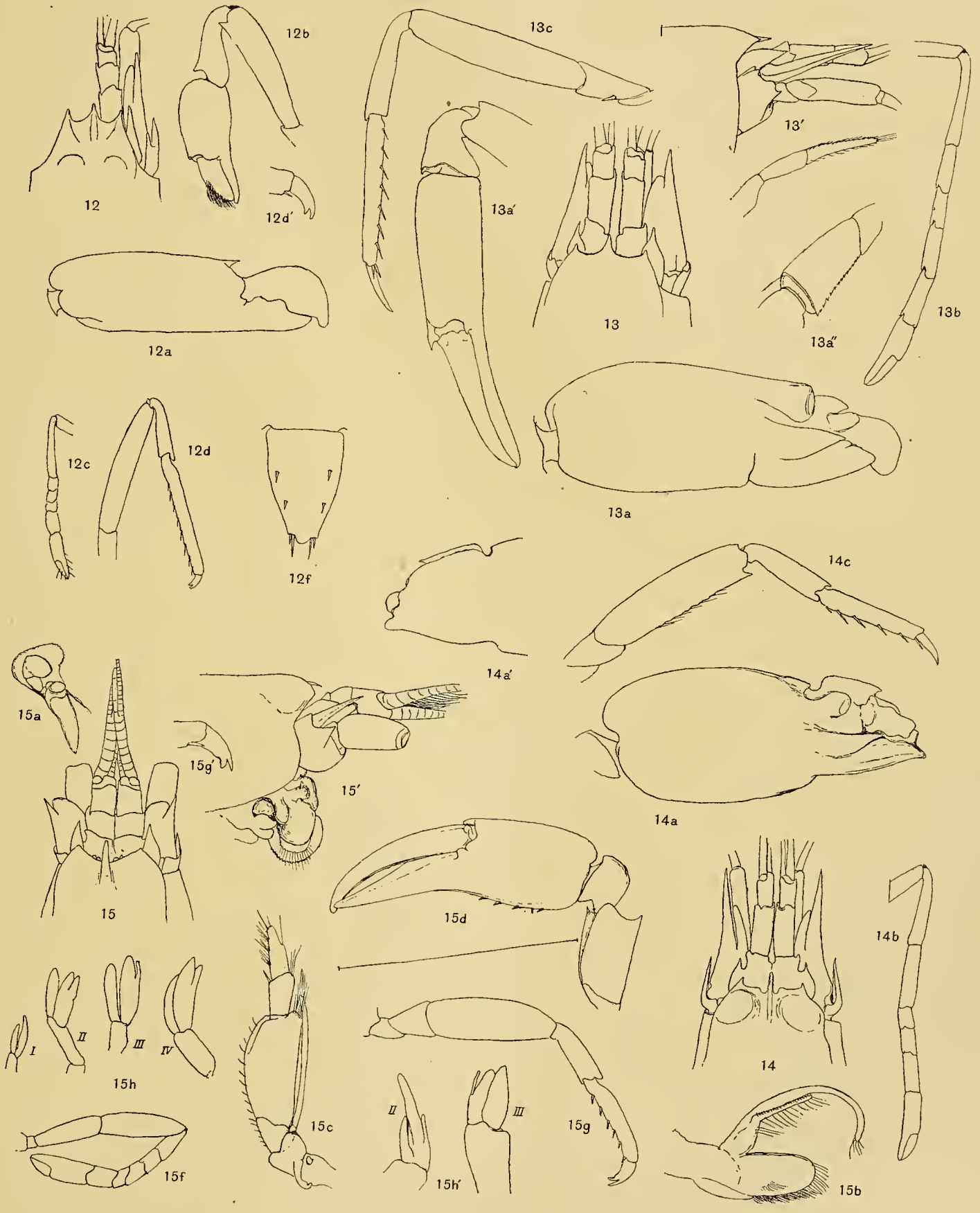
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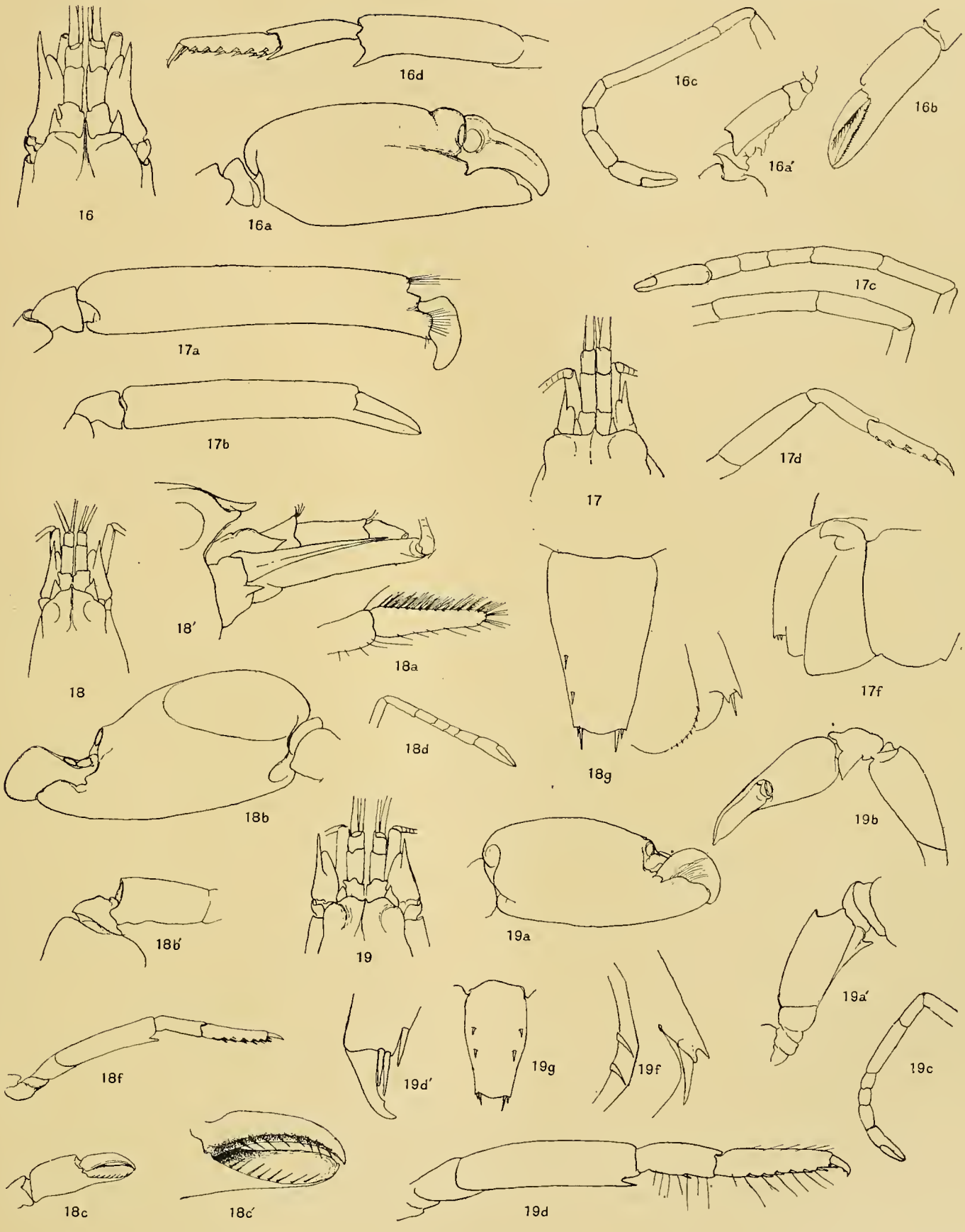
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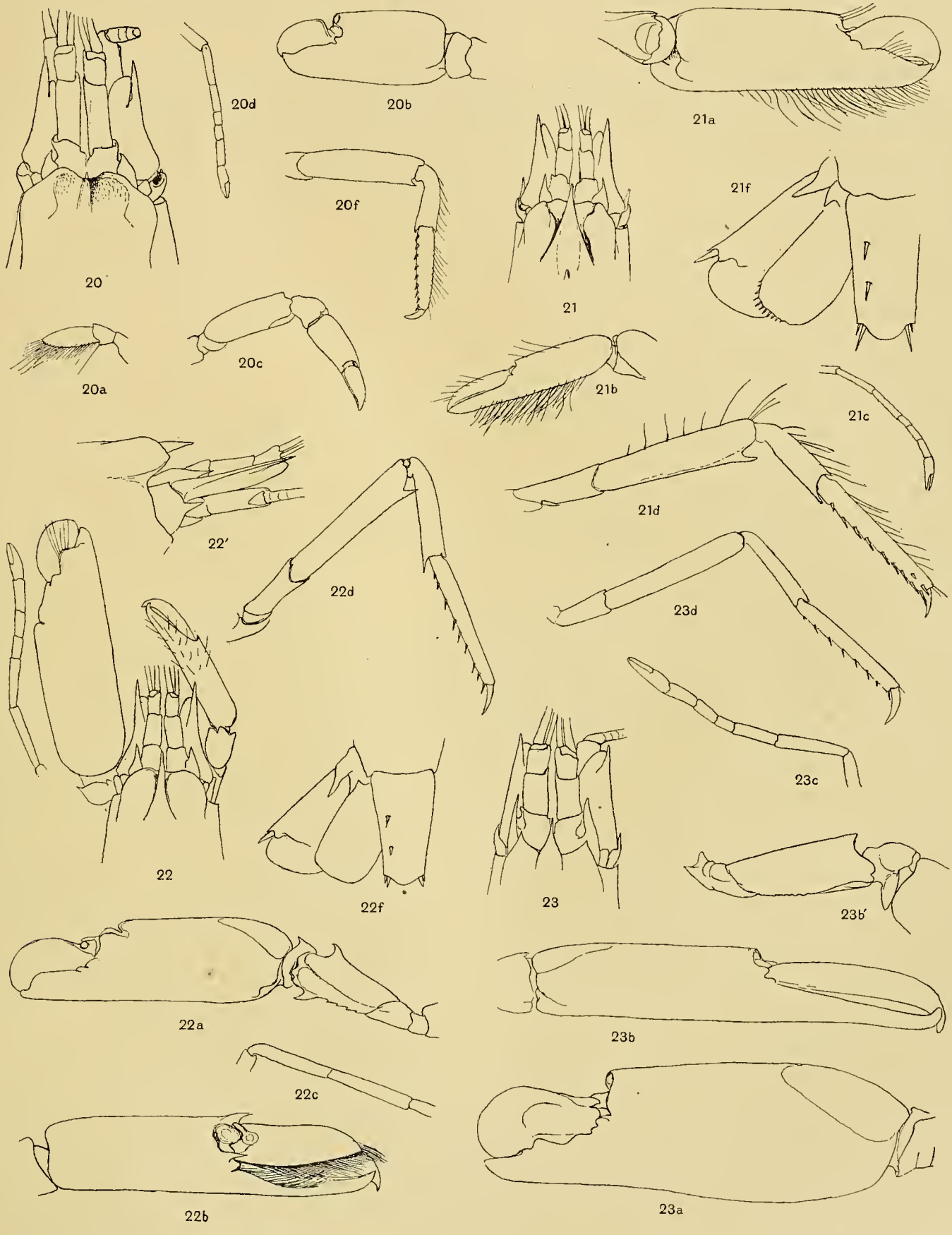
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ALPHEIDAE

No. XI.—ON THE CEPHALOPODA OBTAINED BY THE PERCY SLADEN TRUST EXPEDITION TO THE INDIAN OCEAN IN 1905.

By G. C. Robson, B.A.

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(Communicated by Prof. J. Stanley Gardiner, M.A., F.R.S., F.L.S.)

(Plates **65**, **66**, Text-figs. 1—6.)

Read 17th June, 1915.

An examination of the Cephalopoda obtained by the "Sealark" on her cruise in the western regions of the Indian Ocean has been delayed since the return of the expedition in 1905 until the beginning of the present year [1914] when Prof. Gardiner placed them in the author's hands.

The collection consists of eighteen species representing ten genera and includes a new genus and two new species. Although no very remarkable forms were obtained, the collection as a whole is not without interest, while some of the anatomical features revealed by dissection are of importance.

A peculiar feature of this collection is the total absence of *Myopsida* (*Loligo*, *Sepia*, etc.). This group usually being of a littoral habitat their absence in conjunction with the relatively large number of pelagic and abyssal forms might be taken to shew that the "Sealark's" work was confined to deep-sea dredging or tow-netting far from land. This however was not the case. As will be seen from a study of the stations from which the various species were obtained some of the Polypods were taken at very moderate depths off the islands at which the "Sealark" touched: so that the absence of Myopsida is difficult to account for.

In the present state of our knowledge of the group, Cephalopoda are a rather unprofitable class for use in zoogeographical studies. Those that are well known (the Polypods, squids and cuttlefish) have usually a very extensive range (or what appears to be so), being for the most part powerful swimmers. For example, *Polypus fontanianus* ranges from Chili to the Indian Ocean; while *Stenoteuthis bartramii* is cosmopolitan. The delicate abyssal forms, on the other hand, are so little known at present that it would be useless to generalize on their distribution.

We have also to bear in mind the fact that the diagnoses of a great many species of Cephalopoda are based upon external characters of doubtful value, and that a different view of their distribution may be taken when students of this group have paid more attention to the description of internal parts. Distributional areas at present ranging over many degrees of latitude and longitude may by this process become more restricted. The habits of the majority of these animals, however, do not leave much ground for

assuming that they will ever prove as interesting to the zoogeographer as land and fresh-water mollusca have been.

Whenever possible, attention has been paid to the anatomy of the forms included in this collection, and several points of interest have been revealed. The author has been struck, while in the course of this work, with the necessity for a more intensive study of these animals for the purposes of systematic zoology. Any worker familiar with the Cephalopod mandible and radula will recall how at first sight these structures differ to a remarkably slight degree in forms placed very widely apart. It seems likely, however, that closer study will reveal differences between the radulæ of such forms. The author has been impressed by the way in which, in apparently similar radulæ of forms otherwise very distinct, certain elusive and subtle differences may remain constant over a series of examples. The shells of certain groups of land mollusca have been separated into a number of species which, to the ordinary observer, exhibit very little difference one from another. It is claimed by conchologists that the differences between them are constant, however subtle and minute they may be. Very much the same sort of thing may be found by intensive study among the Cephalopoda.

Among the internal organs the author has found that the genitalia and heart are frequently strongly characterised; and it often seems that for a provisional arrangement these organs would supply a more useful clue to identity than the radula and mandible. On the other hand due care has to be exercised, especially with regard to the heart, that characteristics such as are probably occasioned by the temporary physiological state of such organs are not registered as of diagnostic value.

The author is indebted to Dr W. E. Hoyle for information with regard to the Cranchiidæ, and to the Rev. Dr H. M. Gwatkin for the loan of a series of radula-preparations which has been of great value in determining the affinities of certain forms.

The types and a series of other specimens have been presented by Prof. Gardiner to the British Museum.

The following arrangement has been adopted from Pelseneer (14), Pfeffer (16), and Chun (2).

Class CEPHALOPODA.

Order 2. DIBRANCHIA.

Suborder 1. DECAPODA.

Tribe I. ŒGOPSIDA.

Œgopsida libera.

Family 2. **Onychoteuthidæ.**

Onychoteuthis, sp. (immature).

Teleoteuthis, sp. (immature).

3. **Enoploteuthidæ.**

Abralia (*Compsoteuthis*), sp. (immature).

,, sp. (immature).

Family 6. **Benthoteuthidæ.**

Chunoteuthis minima, n. gen., n. sp.

8. **Ommatostrephidæ.**

Stenoteuthis bartramii (Le Sueur).

11. **Chiroteuthidæ.**

Chiroteuthis (*Doratopsis*) *exophthalmica* Chun.

Œgopsida consuta.

Family **Cranchiidæ.**

S.-fam. i. **Cranchiinæ.**

Liocranchia gardineri, n. sp.

S.-fam. ii. **Taoniinæ.**

Taonidium, sp. (immature).

Suborder 2. OCTOPODA.

Tribe II. TRACHYGLOSSA.

Family 3. **Polypodidæ.**

Scaeurgus unicirrhus Tiberi.
Polypus fontanianus D'Orb.
„ *arborescens* Hoyle.
„ *gardineri* Hoyle.
„ *horridus* D'Orb.
„ ? *venustus* Rang.
„ *granulatus* Lamarck.
„ *L.* Hoyle.
„ *P.* n. sp. (?).

ŒGOPSIDA. Family 2. **Onychoteuthidæ.**

1. *Onychoteuthis* sp.

One example, sex indeterminate, young, from lat. 20° S. between Maldives and Chagos, 50 fms. (1537).

One example, sex indeterminate, young, from between Salomon and Diego Garcia, Chagos, surface (1540).

These examples are very immature, but they exhibit considerable resemblance to young examples of this species figured by Pfeffer (16).

2. *Teleoteuthis*, sp.

Two examples, young (7—8 mm.) from Amirante Bank, surface (1539).
Four „ „ ? locality (1409).

The above enumerated examples have been referred to this genus with much hesitation. The general appearance is in fairly close conformity with young figured specimens referred to the genus, (10) and (13); but they are rather more elongate than is apparently

usual at this stage and the arms are shorter than customary. The suckers of the tentacular arms are arranged in a formation more closely serried than those figured by Pfeffer and Chun.

Family 3. **Enoploteuthidæ.**

Abralia (*Compsoteuthis*), sp.

One example, sex indeterminate, from off Providence, between surface and 10 fms? (1536).

The specimen is in a very poor condition, the head and arms being damaged, but from the characters that are apparent it is probably referable to this genus.

Another very badly damaged specimen from 250 fathoms off Desroches Atoll (1532) is possibly referable to *Abralia* also.

Family 6. **Benthoteuthidæ.**

Chunoteuthis minima, n. gen. n. sp. (Plate **65**, fig. 2).

One example, sex indeterminate, from between Alphonse and Providence Islands, 900 fathoms (1528).

This specimen has been the source of a considerable amount of trouble. In the first place, it arrived in a very shrivelled-up condition, apparently having suffered desiccation at some time, and in consequence a good many of its external features have been obliterated. In the second, it does not readily fall into line with any described and figured Œgopsid genus. Even its family relationships are very doubtful. The result is that, although it certainly calls for description, its exact position is extremely problematical, seeing that examination of the anatomy and mantle cavity is denied by the state of its preservation. After much hesitation it has been decided to assign it to the Benthoteuthidæ on the strength of its general superficial appearance.

Chunoteuthis, n. gen.

General appearance. Very small in size* (length of mantle from apex to base of arms, 3 mm., length of tentacular arms, 5·5 mm. (?+1 mm.), width 1 mm.). The head is large and oblong in shape with very large, prominent eyes upon which no traces of accessory light organs are to be seen. The body is saccular but laterally compressed† with a well-marked dorsal carina and a very prominent nuchal protuberance on the dorsal mantle edge. Posteriorly two small subquadrate fins are found.

The tentacular arms are very long and slender. The club is not very much expanded and the suckers upon it are irregularly disposed. The sessile arms were so tightly entangled that they could not be separated without damage. They are relatively long and apparently subequal in size, and all exhibit prominent suckers.

The colouring has of course disappeared, but traces of dark chromatophores appear upon the arms.

C. minima, n. sp., with the characters of the genus.

Type in the Zoological Department of the British Museum.

* The adult condition is testified by the length of the arms both sessile and tentacular.

† It is not impossible that the lateral compression may be an artefact character.

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Family 8. **Ommatostrephidæ.** *Stenoteuthis.*

S. bartramii (Le Sueur). (Plate **66**, fig. 1.) Journ. Acad. Nat. Sci. Philadelphia, ii. pt. 1. 1821. 90 t. 7. (For a full synonymy cf. Pfeffer (16).)

Two examples, ♂ (young), "flew on board" 30 miles W. of the Centurion Bank (Chagos Is.), (1416).

A complete account of the anatomy of this cosmopolitan form is very desirable on account of its peculiar "flying" habit. Unfortunately the amount of material to hand prohibits the preparation of such an account in the present instance; nor, in fact, does the condition of the animal here described from dissection, favour a satisfactory account, particularly with regard to the genitalia.

The *branchiæ* are slender and elongate resembling a quill pen in general appearance. They are relatively very long, in individuals of 80 mm. length measuring 33—34 mm. There are 56 (± 1) laminæ, the distal ones being very minute. The scheme of plication, which is tolerably simple, is shewn in fig. 1 *c*.

The *anus* exhibits two lateral valves, elongate and auriform in appearance.

Internal anatomy.

The *heart* (fig. 1 *b*) is fairly regular in shape and is elongate in its sagittal axis. The anterior and posterior aortæ originate at the anterior and posterior extremities. In the two specimens there were no traces of auricles. It is possible that the swellings at the base of the efferent vessels represent these.

The *branchial hearts* are large, irregularly-shaped organs, each exhibiting an appendix and partly separated from it by a very deep groove in which the afferent vessel terminates.

Posteriorly the posterior vena cava appears to arise from two very long and narrow blood sinuses. From one of these a main vessel was found debouching into the vena cava. On the other side the specimen was too badly preserved to allow dissection to trace a similar connection; though there is no reason to suppose an asymmetrical condition.

Such blood sinuses are apparently rare in the Cephalopoda and may be in some way related to the animal's habit of "flying" or leaping from the water.

The *renal papillæ* are found about 2 mm. from the base of the branchiæ between the latter and the intestine.

The *stomach* appears to bear two appendices (fig. 1 *a*), one of these a rounded sac lying anteriorly, the other a narrow elongate structure occupying a terminal position.

The first appears to be plicate internally and may represent the true stomach described for *Loligo pealeii* by Verrill (18), while the second may be the equivalent of his "caecal lobe" described for the same animal.

The *testis* is a thin elongate organ closely applied to the left-hand blood sinus and terminating anteriorly in a piriform mass of coiled tubes, the external aperture being dorsal to the gill heart and just near its posterior extremity. From this aperture project the ends of two tubules, apparently the terminal portion of Needham's sac and the prostate (?). It is very much to be regretted that the condition of the single animal available for dissection precluded a complete examination of the genitalia.

It may be taken for granted that this animal does not "fly" in the strict sense of the word, i.e. it does not maintain itself or effect progress by repeated muscular efforts out of the water. It should more correctly be called the "leaping squid," as it is pretty clear that by the action in question it merely projects itself from the water by a single effort. It has been suggested that the occurrence of the animal out of the water may possibly be merely accidental. It is a powerful swimmer and it is possible that in a rough sea it might accidentally shoot out of the water when swimming close to the surface. From D'Orbigny's account (4), however, in which he describes the considerable altitude (15—20 feet) to which it leaps and the way it is preyed on by sea-birds, I am inclined to think it executes the characteristic leap voluntarily in order to escape from its enemies. D'Orbigny says the habit has been observed in some species of *Sepioteuthis* as well. He is of opinion that it is effected by the well-developed fins on the arms; but, however much the latter may facilitate the leap, they can scarcely initiate it. The latter function is probably performed by the powerful trunk muscles exercising an abnormal pressure on the contents of the mantle cavity. It is possible that the power is possessed by a good many other squids, but has only been observed in *S. bartramii* by reason of its plentiful occurrence.

Liocranchia gardineri: Fig. 1, Mandibles; Fig. 2, Radula. A. Admedian tooth. (Cam. $\frac{1}{12}$ nom. imm. × 6 oc.)

Family 11. **Chiroteuthidæ.** *Chiroteuthis.* Subgenus *Doratopsis.*

Chiroteuthis (*Doratopsis*) *exophthalmica* Chun. Deutsche Tiefsee-Expedition. Bd. 18, T. i. p. 290, 1910.

A single specimen, sex indeterminate, from between Peros and Salomon, Chagos, 600 fms. (1535).

Distribution previously known: Madeira and South Indian Ocean.

The specimen is very much damaged, only the head, tentacles and a small part of the body remaining. The identification is provisional.

Family **Cranchiidæ.** *Liocranchia.*

Liocranchia gardineri, n. sp. (Plate **65**, fig. 1 and Text-figs. 1 and 2.)

One example, sex indeterminate, from off Desroches Atoll, 200 fms. (1530).

It is very much to be regretted that only a single specimen of this interesting form was obtained, as owing to the size and structure it is impossible to dissect out any of the internal organs or even to open the mantle cavity without seriously damaging the specimen.

Dimensions. Max. length of body (apex—base of arms), 10 mm.
„ width „ „ 7 mm.
Length of tentacular arms, 9 mm.

The surface of the *mantle* is smooth, semi-transparent, and of a faint ochreous colour. A number of small dark-red chromatophores are found dorsally scattered sparsely over the posterior half and disappearing anteriorly and ventrally. A couple of chromatophores appear in a dorsal position on the head, one on each side of the median line.

The body is saccular and rounded posteriorly, where, in a subterminal position, a pair of small quadrate fins appear on the back.

The *funnel* is large and projects more than 2 mm. beyond the edge of the mantle.

The *sessile arms* exhibit the formula 3. 4. 2. 1.

The *tentacular arms.* Only one of them is complete. They are solid, truncheon-like structures for more than 2·5 mm. of their length, after which they rapidly taper to a very fine strand continued to the "club" which is 2 mm. long and well developed.

The lateral and admedian cartilaginous rows are furnished with numerous pyramidal tubercles. There are no median dorsal cartilaginous tubercles as in *L. reinhardti.*

The *mandibles* (cf. Text-fig. 1).

The *radula.* The admedian lateral tooth is enlarged so as almost to match the second lateral in size. There would appear to be no small marginal tooth, though it is impossible to be certain of this point.

Type in the Zoological Dept. British Museum.

Cranchiidæ. S.-fam. ii. **Taoniinæ.**

Taonidium, sp.

A damaged example, sex indeterminate, juvenile, "16:5:05," from 125 fathoms (1534). Possibly referable to *T. suhmii* (Hoyle).

Family **Polypodidæ.** *Scaeurgus.*

Scaeurgus unicirrhus Tiberi. (Plate **66**, fig. 2.) Bull. Soc. Malac. Ital. 1880, p. 5 (after Delle Chiaje, n. n.).

One example, ♀, from 123 fms. S. de Malha (1406).
„ ♂, „ 125 „ „ (1404).

Distribution previously known: Mediterranean region.

The examples are unmistakably representatives of this species, which as far as the author has been able to satisfy himself, has never been previously recorded E. of the Mediterranean area.

It is desirable to add some further notes to the already existing knowledge of the anatomy of this form. One or two points appear to be of considerable importance.

To the description of the *hectocotylus* given by Jatta (9) we may add the fact that there is no communication between the main sperm-path (the marginal sulcus) and the deep cleft at the extremity of the hectocotylus described by Jatta (p. 237). The function of this cleft is therefore somewhat difficult to understand, unless we assume that the whole extremity is applied as a sucker for prehensile purposes.

The *male genitalia* have been already described by Marchand (13) and do not appear to differ in any important respects from those of *Polypus*.

The *female genitalia* in this species appear to differ from those of *Polypus* somewhat (fig. 2). The oviducts leave the ovary in the form of broad, strap-like ducts, narrowing down as they approach the oviducal glands. The latter are relatively very large. The anterior portions of the oviducts do not again contract on quitting the oviducal glands but continue as stout muscular tubes to the oviducal aperture which is situated upon a round elevated papilla of characteristic shape surmounted by a tuft of small (possibly glandular) lobes which surround the aperture.

Coelom and coelomic organs. The limits of the *kidney* are shewn in fig. 2. It is a voluminous organ and possesses extensive glandular bodies. It is divided by the afferent and efferent branchial vessels into three portions, the long axes of which are transverse in two cases, antero-posterior in the third. The latter is small and contains the reno-pericardial orifice which is situated at a very short distance from the entrance to the renal orifice; while the former are extensive and ramify among the digestive organs in such a way as to make it difficult to follow them.

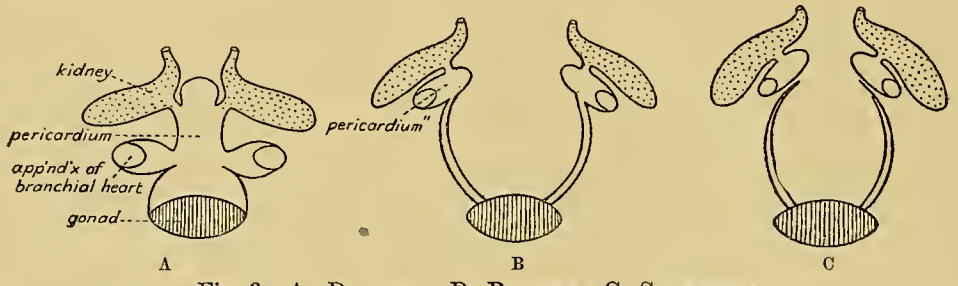


Fig. 3. A. Decapod. B. Polypus. C. Scaeurgus.

The so-called *aquiferous duct* leaves the capsule of the ovary from a very anterior position and running backwards comes into close contact with the pericardium in the external tissues of which it runs as a fine fibrous strand gradually diminishing in size until it entirely vanishes near the apex of the pericardium. Very careful dissection of both sides failed to reveal any opening of this duct into the pericardium. If this observation should be confirmed by future investigators, it will be permissible to suppose that morphologically *Scaeurgus* carries us a step further than *Polypus* in the obliteration of the coelomic cavity, and would represent the third stage in the annexed diagram in which the gradual reduction of the coelomic cavity of the Cephalopoda is illustrated (Text-fig. 3).

This process of separation of the gonad from the remnant of the coelom would be finally completed by the condition observed in *Argonauta* and *Philonexis* in which the aquiferous canals are suppressed altogether (Pelseneer (14)).

It is necessary to emphasize the fact that these observations are founded upon dissection of a single specimen and that due caution is necessary in employing them for any generalization.

The *anus* is in the form of a transverse slit at the lateral extremities of which are found pedunculate flaps of skin which apparently function as valves and are capable of being folded over the aperture.

The *heart* (fig. 2 *a*) is asymmetrical, rectangular on the left side and drawn out by the

posterior aorta upon the right side. Between the right and left efferent vessels and the anterior aorta are found two small vessels which run to the surface of the renal capsules. The genital artery leaves the heart in a median position in the antero-ventral region. The auricles are small, simple and roughly triangular in shape.

The *branchiæ* are shewn in fig. 2 *b*.

Polypus.

1. *P. fontanianus* (D'Orbigny). (Plate **66**, fig. 5.) Amérique Méridionale, p. 28, 1835.

One example, ♀, Coetivy (1405).

Distribution previously known: Peruvian and Patagonian regions. Indian Ocean.

Originally regarded as a South American form, this species has recently been recorded from the Indian Ocean (Joubin (12)). The enlargement of the proximal suckers of both lateral arms, regarded by D'Orbigny as a character diagnostic of the species but now found to be a sex-limited character found in other species, has been already discussed by Hoyle (5). It may possibly serve a prehensile function similar to that discharged by the enlarged thumb of male frogs. Insemination being effected among the Cephalopoda by means of the hectocotylus it would appear unnecessary for the male to be supplied with prehensile organs. Very little, however, is known of the actual process of sperm-transference and coitus, and it may be possible that some form of amplexus takes place in some species of Polypus in which the enlarged suckers seen in *P. fontanianus* and *P. gardineri* are used. That amplexus may take place in some members of a genus and not in others is attested by Boulenger's description (1) of fecundation in Batrachians, according to which amplexus occurs in *Molge aspera* and *M. montana* but not in *M. cristata* and *M. alpestris*.

The *mandibles*. The upper is erect and exhibits a well-pointed rostrum; in the lower the anterior laminæ are provided with a marked posterior median angulation.

In the *radula* the median tooth appears to exhibit three phases, one with lateral cusps placed about half-way down from the apex of the median cusp, one with similar cusps placed lower down and one with cusps in both positions. The third lateral tooth is stout, recurved at the tip and its base is well developed.

The *anus* is situated within a circular depression in the mantle cavity and is furnished with two elongate valves.

The *heart* is markedly asymmetrical. The genital artery leaves it towards the right side, the anterior aorta well on the left with the root of the posterior aorta occupying the opposite angle. Shortly after it leaves the ventricle the anterior aorta gives off a small vessel which apparently runs to the stomach and intestine.

The right auricle was found to be in an abnormal condition inasmuch as it was enlarged to a size exceeding that of the ventricle itself. Dissection revealed the presence in it of a mass of coagulated blood. The left auricle being, as is usual in the Cephalopoda, of small size, one is forced to conclude that the distension of the right auricle is abnormal, due either to pathological causes or to some temporary derangement of the circulation due possibly to the circumstances of the animal's death.

The *genitalia* (♀) do not call for any particular comment. The oviducal glands are very small, the ovary is symmetrical and the oviducal apertures are simple and placed very near the anus. The genital artery enters the capsule of the ovary in an anterior position between the two ducts which are separate at their origin.

The *branchiæ* (fig. 5 *b*, *c*) have their laminæ diagonally plicate.

2. *Polypus arborescens* Hoyle. (Plate **66**, fig. 3.) Rept. Pearl Oyster Fisheries of Ceylon, (Roy. Soc.) Pt. II. p. 189, 1904.

One example, ♀, from Cargados, 30 fms. (1411).

One example, ♀, from same (1403) (dark variety ?).

These are unmistakable examples of Hoyle's species.

Distribution previously known: Ceylon; Zanzibar; Pacific Ocean.

The *mandibles* (cf. fig. 3 *b*).

The *radula*. The first lateral tooth is rather deep, the second singularly long and accompanied by a rather slender third lateral. The median tooth exhibits a very deep basal notch.

The *internal organs*. In the example No. 1411 the ovary was so much enlarged and reflected posteriorly that it covered the whole of the branchial complex and practically obscured the gills themselves from view. Apparently by reason of this development of the ovary (no doubt attained by numerous other species at the time of sexual maturity) the following somewhat anomalous condition of the branchial complex and surrounding organs is to be noted:

(i) the gills lie at a very low level,

(ii) the heart is displaced very much to the right of the median line,

(iii) the oviducts instead of originating from the dorsal surface of the ovary and running downwards are found well past the middle of the mantle cavity on the ventral side of the ovary, running first upwards and then downwards.

The other example, which is very much darker in colour, shewed no such development of the ovary, the gills were more posterior in position and the oviducts pursued a more normal course. The heart, however, is still placed well towards the right-hand side. Comparing the two examples we may safely conclude that at sexual maturity the extensive development of the ovary tends to displace the organs of the branchial complex in the manner described above.

In both forms the *heart* is peculiarly elongate and piriform, the posterior aorta occupying the apex and the two efferent vessels and the anterior aorta the base.

3. *Polypus gardineri* Hoyle. Fauna and Geography of the Maldive and Laccadive Archipelago (J. S. Gardiner). Cephalopoda. Vol. II. Supp. I. p. 976.

One example, ♂, from Coetivy, 32 fathoms (1419).

It was impossible to make any dissection of this example owing to the imperfect state of preservation. Superficially it agrees in all respects with Hoyle's type description, the lateral arms exhibiting enlarged suckers (v. supra, p. 437).

Hoyle supposed that this form might possibly be the young of *P. fontanianus*; but comparison of the radula of these two forms does not support this possibility.

The *hectocotylus*. This was referred to by Hoyle as comparable to that of *P. vulgaris*. It should however be pointed out that in the present example of *P. gardineri* the hectocotylus differs from that of *P. vulgaris* in that the seminal groove is well covered over by its external edge, though it is possible that the loose external edge may be contracted or relaxed according to the state of preservation.

The *radula* (Text-fig. 4).

Fig. 4. Polypus gardineri: Radula. Cam. 6 oc. × 6 obj. Reich.

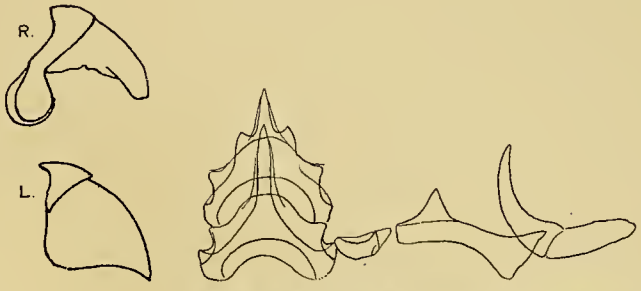


Fig. 5. Polypus horridus: Radula and Mandibles. Cam. 6 oc. × 6 obj. Reich.

4. *Polypus horridus* D'Orb. Tabl. méthod. Ann. Sci. Nat. vii. p. 54, 1826.

One example, ♂, from Amirante, 20—25 fathoms (1418).

,, ♂, ,, 25—80 ,, (1401).

,, sex indeterminate, young, Amirante, 30 fathoms (1420).

Distribution previously known: Zanzibar; South Africa; Red Sea; Ceylon; Malé Atoll.

Mandibles. The distal extremity of the anterior ramus of the lower mandible is markedly turned back and expanded. The upper mandible is very erect and anteriorly presents a remarkably straight front.

Radula. The first laterals are elongate. The second laterals exhibit a very heavy external inferior angle, while the third laterals are tolerably stout. (Text-fig. 5.)

5. *Polypus venustus* Rang. Magasin de Zoologie, Ann. 5–8, 1835–8, fig. 93.

One example, ♀, from between Peros and Salomon, Chagos, 20 fathoms (1541).

The author has been unable to find any modern work upon this species. There is a brief reference to it in Tryon's Manual of Conchology, vol. I, where the distribution is given as "Algiers: Island of Goree." Tryon places it among his indeterminable species and considers it to be a young specimen.

The specimen obtained from the above locality agrees with Rang's description (and figure) pretty closely. In one or two respects it differs, e.g. the chromatophores are not aggregated into a median dorsal clump but are found clustered towards the anterior end of the mantle. Nor are the ventral chromatophores disposed in the sparse even rows indicated by Rang's figure but are more irregularly distributed. Otherwise the description given by Rang applies very adequately to this specimen. Particularly significant is the agreement on the following characters : " un peu dorée à la partie dorsale " and " les bras... avec des séries de petites taches dorées répondant aux ventouses."

Tryon's supposition that this is a young form is borne out by the delicacy and fragility of the tissues but by nothing else. The condition of the arms and suckers and the general appearance, which is peculiar and characteristic, do not suggest that it is young.

It is very much to be regretted that only a single specimen was found, otherwise some interesting anatomical characters might have been revealed. The branchial cavity alone was opened and found to reveal at least one interesting feature. As far as the radula is concerned there is nothing to separate it from a normal *Polypus*, but the single mandible examined is somewhat peculiar.

The *branchiæ* occupy a peculiar position in the mantle cavity, being inserted into the visceral mass at a remarkably high point, well up into the apex of the mantle cavity. In form they are extremely long, flat and strap-like.

The *radula* (Text-fig. 6) is normal. In the median tooth there appear to be two main lateral cusps, the separation and approximation of which in different teeth give rise to two main types indicated in the figure.

Fig. 6. POLYPUS VENUSTUS: Radula. Cam. 6 oc. × 6 obj. Reich.

The *lower mandible* alone was examined, the upper member of the pair being somewhat damaged. It is peculiar in exhibiting an excessively deep notch and a very small anterior lamina.

Distribution previously known: "Algiers: Goree."

6. *Polypus granulatus* Lamarck. Mém. Soc. Hist. Nat. Paris, i. p. 20, 1799.

One example, about one-third grown, ♀ (?), from Amirante, 22—85 fathoms (1402).

I share Dr Hoyle's view (5, p. 80) as to the difficulty of identifying the *S. rugosa* of Bosc to which this form has been referred by Férussac and D'Orbigny.

7. *Polypus L.* Hoyle. Fauna and Geography Lacc. and Mald. Archip. (J. S. Gardiner), Vol. ii. Supp. 1. 1905.

One example, sex indeterminate, young, Amirante, 20—40 fathoms (1407).

This young example agrees in all respects with the form recorded by Hoyle, except that there are two, not three, ventral chromatophores.

8. *Polypus P.* (Plate **65**, fig. 3; Plate **66**, fig. 4.)

One example, ♀, from off Peros, Diamant Is., 12 fathoms (1410).

This specimen proved to be too young to be treated as a new species. It exhibits affinities with *P. horsti*, *P. fontanianus* and *P. gardineri*, but at the same time appears to be specifically distinct from these forms.

The *body* is posteriorly rounded and sac-like, the eyes are tolerably prominent and between the latter the head is slightly wider than the body. The skin is wrinkled

dorsally, probably by the action of the preserving agent, and exhibits a sparse array of papillæ some of which are multifid. There are a few papillæ round each eye.

The *arms* exhibit the formula $2 = 3 = 4.1$. There is a weakly developed *umbrellar membrane* extending a few millimetres up each arm.

The colouring is a brownish purple on the back, passing to a very pale yellowish brown ventrally, the whole covered with numerous black chromatophores. Very characteristic is an oval patch of an intense blue-black colour, about 2 mm. long, situated on either side somewhat posterior to the eye at the base of the third arm. Such patches are found in this position in *P. horsti* (Joubin (12)), but although this is a common characteristic between the two species, the radulæ, as well as other structures, differ too widely to allow of uniting the two forms (cf. Plate **66**, fig. 4 *a* and Text-fig. of Hoyle (6)).

Radula (cf. fig. 4 *a*).

Internal anatomy. The *heart* is relatively very large and is markedly rounded; the efferent vessels enter it at equal distances from the anterior aorta. The auricles lie very near the surface in close proximity to the renal aperture.

The *ovary*, in accordance with the immature age of the specimen, is very small, much smaller in fact than the capsule. The oviducal glands are also very small and the oviducts long and slender. These open low down in the mantle cavity towards the median line in the region of the kidney.

Indeterminate juvenile examples.

A single very small example from "6. 10. 05," 140 fathoms (1538). The only salient characters are its squat build and the plentiful scattering of brownish-black chromatophores all over the mantle.

A single juvenile example from Providence, 39 fathoms (1408). Possibly young form of *P. granulatus*.

LIST OF WORKS REFERRED TO.

1. Boulenger, G. A. Zool. Jahrb. Bd. vi. Syst. p. 447. 1892.
2. Chun, C. Deutsche Tief-See Exped. Oegopsida. 1910.
3. „ Zool. Anzeig. 31, p. 82. 1906.
4. D'Orbigny, A. D. Voy. Amérique Mérid. vol. 5, p. 56. 1847.
5. Hoyle, W. E. "Challenger" Rep. Cephalopoda. 1886.
6. „ P. Z. S. 1907, p. 450.
7. „ Rept. Pearl Oyster Fishery, Gulf of Manaar, (Roy. Soc.) Pt. ii. 1904.
8. „ Fauna and Geography of the Maldive and Laccadive Archipelago (J. S. Gardiner). Cephalopoda (vol. 2, suppl. i.). 1905.
9. Jatta, G. Flora und Fauna des Golfes v. Neapel: Cephalopoda. 1896.
10. Joubin, L. Rés. Camp. Scient. (d'Albert I.): IX. Céphalopodes de l'Atlant. Nord. 1895.
11. „ XVII. „ prov. des campagnes de la "Princesse Alice." 1900.
12. „ Notes: Leyden Museum, xx. pp. 21—28. 1898.
13. Marchand, W. Zeitschr. für Wiss. Zool. 86. 1907.
14. Pelseneer, P. Lankester's Treatise on Zoology. Mollusca. 1906.
15. Pfeffer, J. Jahrb. Hamburg. Wiss. Anstalt. xvii. 1910.
16. „ Plankton Exped. Oigopsiden. 1912.
17. Posselt, H. J. Vidensk. Meddelels. Natur. For. 1891, p. 301.
18. Verrill, A. E. Trans. Connecticut Acad. Sci. v. 1879.

EXPLANATION OF PLATES.

Plate 65.

Fig. 1. *Liocranchia gardineri*, n. sp., anterior and posterior aspects (× 5).

Fig. 2. *Chunoteuthis minima*, n. gen., n. sp., anterior and posterior aspects (× 17).

Fig. 3. *Polypus P.*, anterior aspect; 3*a*, funnel; 3*b*, oral aspect shewing disposition of suckers (× 2).

Plate 66.

Fig. 1. *Stenoteuthis bartrami* Lesueur, general appearance of mantle cavity; 1*a*, stomach and caeca; 1*b*, heart; 1*c*, laminæ of gills, seen from above.

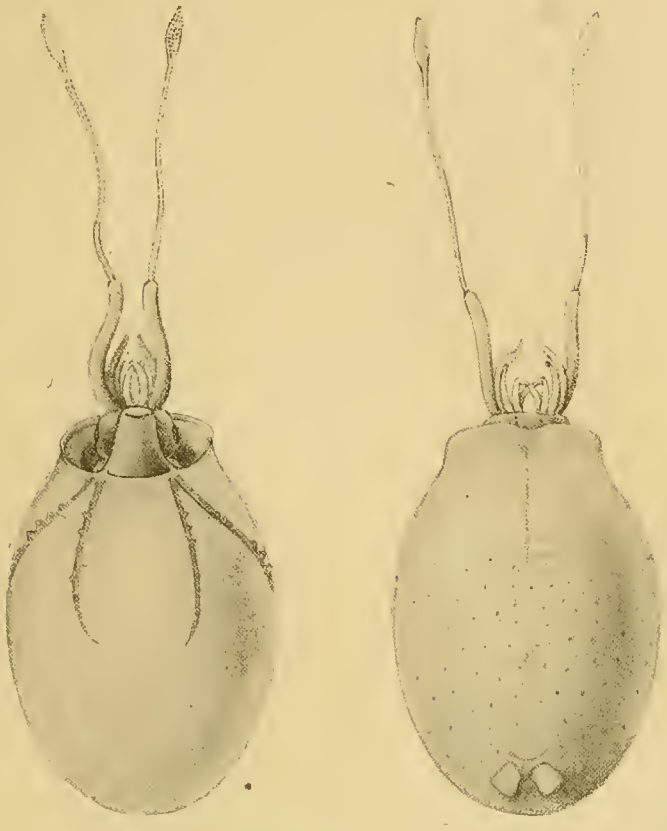
Fig. 2. *Scaeurgus unicirrhus* Tiberi, genitalia, etc.; 2*a*, heart; 2*b*, gill.

Fig. 3. *Polypus arborescens* Hoyle, female in breeding season; 3*a*, diagrammatic representation of the heart and female genitalia shewing asymmetrical condition of these organs due to growth of ovary at sexual maturity; the dotted outline shews normal position of these organs; 3*b*, mandibles; 3*c*, radula (4 oc. × 6 obj.).

Fig. 4. *Polypus P.*, heart and genitalia of female; 4*a*, radula (4 oc. × 6 obj.).

Fig. 5. *Polypus fontanianus* (D'Orbigny), heart shewing enlarged right efferent artery, probably pathological; 5*a*, ovary, etc.; 5*b*, gill; 5*c*, a single gill lamella; 5*d*, mandibles; 5*e*, radula.

Lettering: *AA*=anterior aorta; *A*, *a*=auricle; *a.d.*=aquiferous duct; *b.h.*=branchial heart; *c.o.*=capsule of ovary; *e.v.*=efferent branchial vessel; *GA*=genital artery; *g.o.*=genital aperture; *LEV*=left efferent vessel; *MES. V.*=mesenteric vessel; *od*=oviduct; *ov*=oviducal gland; *PA*=posterior aorta; *REV*=right efferent vessel; *r.p.a.*=reno-pericardial aperture; *x*, *y*=renal vessels.



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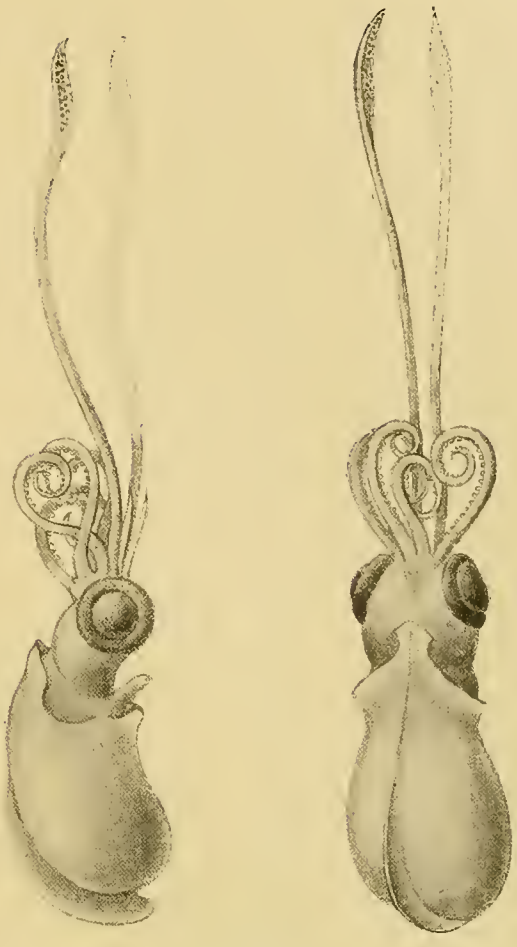

Fig. 2.

Fig. 3 a.

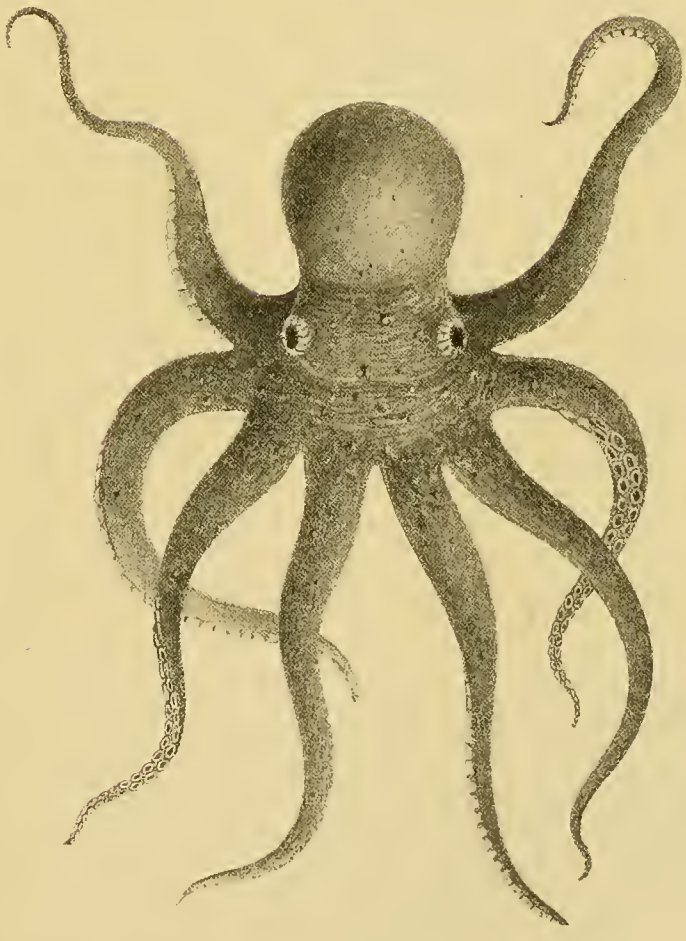

Fig. 3.

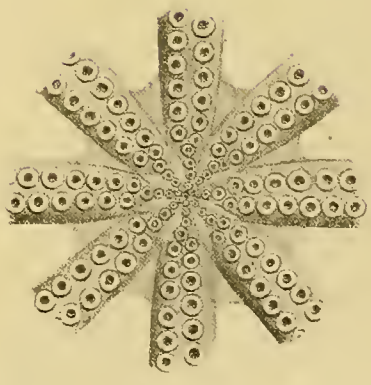

Fig. 3 b.

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ERRATUM.

p. 376, line 16, *for* (Dorna) *read* (Dana).

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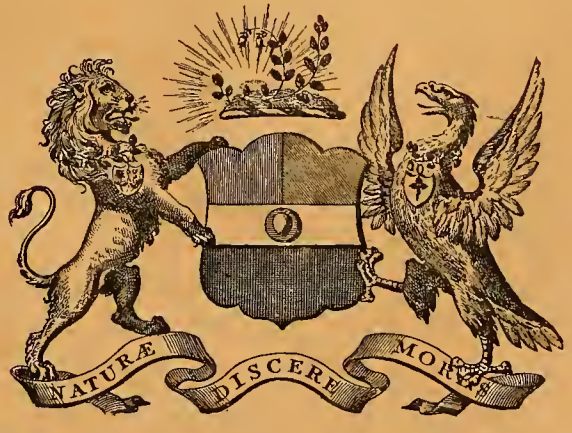

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	Part VI.	1910	0	11	0	0	8	3
	Part VII.	1910	0	5	0	0	3	9
	Part VIII.	1911	0	4	0	0	3	0
	Part IX.	1911	0	2	6	0	2	0
	Part X.	1911	0	2	6	0	2	0
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	Part V.	1909	0	2	0	0	1	6
	Part VI.	1910	0	11	0	0	8	3
	Part VII.	1910	0	5	0	0	3	9
	Part VIII.	1911	0	4	0	0	3	0
	Part IX.	1911	0	2	6	0	2	0
	Part X.	1911	0	2	6	0	2	0
	Part XI.	1913	0	4	0	0	3	0
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	Part III.	1913	0	12	0	0	9	0
	Part IV.	1914	1	10	0	1	2	6
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	Part IV	1904	0	6	0	0	4	6
	Part V.	1904	0	6	0	0	4	6
	Part VI.	1904	0	6	0	0	4	6
	Part VII.	1904	0	6	0	0	4	6
	Part VIII.	1904	0	10	0	0	7	6
	Part IX.	1905	0	6	0	0	4	6
	Part X.	1906	0	12	0	0	9	0
	Part XI.	1907	0	12	0	0	9	0
	Part XII.	1907	0	3	0	0	2	3
	Part XIII.	1907	0	6	0	0	4	6
	Part XIV. Index	1907	0	3	0	0	2	3
X.	Part I.	1904	0	3	0	0	2	3
	Part II.	1904	0	8	0	0	6	0
	Part III.	1905	0	9	0	0	6	9
	Part IV.	1905	0	10	0	0	7	6
	Part V.	1906	0	7	6	0	5	3
	Part VI.	1906	0	3	0	0	2	3
	Part VII.	1907	0	3	0	0	2	3
	Part VIII.	1907	0	4	0	0	3	0
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	Part IV. Index	1912	0	5	0	0	3	9
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	Part IV.	1913	0	12	0	0	9	0
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	Part II.	1913	1	1	0	0	15	9
	Part III.	1913	0	12	0	0	9	0
	Part IV.	1914	1	10	0	1	2	6
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